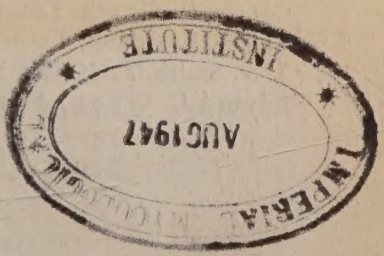
Agricultural Experiment Station

of the

University of Kentucky

FIFTY-NINTH ANNUAL REPORT



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for the year 1946

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(Footnotes on following page.)

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[1] Resigned 6-26-46
[2] Resigned 7-1-46 to 7-1-47
[3] Resigned 5-7-46
[4] Resigned 10-18-46
[5] Resigned 5-15-46
[6] Resigned 11-30-46
[7] Resigned 12-31-46

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[8] Resigned 6-10-46
[9] Trans. to Asst. in Farm Labor 3-1-46
[10] Deceased 1-1-46
[11] Resigned 5-1-46
[12] Resigned 9-14-46
[13] Resigned 9-15-46
[14] On leave 8-1-46 to 8-31-47 Sabbatical

LETTER OF TRANSMITTAL

To His Excellency, Hon. Simeon S. Willis, Governor of Kentucky:

Sir: In accordance with an act of Congress, approved March 2, 1887, entitled, "An act to establish Agricultural Experiment Stations, in connection with the Agricultural Colleges established in the several states under the provisions of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, entitled, "An act to accept the provisions of an act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several states and territories under the act of Congress approved July 2, 1862," I herewith submit the fifty-ninth annual report of the Kentucky Agricultural Experiment Station.

Very respectfully,

THOMAS P. COOPER, Director

ANNUAL REPORT
of the
DIRECTOR OF THE KENTUCKY AGRICULTURAL EXPERIMENT STATION
For the Year 1946

RESEARCH AT the Experiment Station progressed during the year despite the difficulty of securing and retaining well-prepared staff members. Resignations frequently resulted in long delay before the interrupted work could be resumed.

Developing attitudes of farm people toward the results of research are most encouraging. To an ever-greater extent, Kentucky farm people accept research findings and adapt them to their own farm and home operations. Requests by various farm groups for the development of certain fields of study of particular importance to those groups are becoming more numerous. To the fullest extent possible under present operating necessities, the program of the Experiment Station is adjusted to meet these needs. It is impossible to meet more than a small share of these demands for new research, however, without increased personnel, more nearly ample funds to support the work, and a marked expansion in buildings, laboratories, and land for experimental work. More land is needed immediately to carry on and develop further the investigation of grasses and certain other forage crops. Grass is one of Kentucky's large and important crops, and research made so far indicates that much may be accomplished by expansion in this field of study.

Through the years it has been proved that research findings adopted by farmers increase farm income many times over the cost of the research. An example in point is the widespread adoption of work-simplification practices in tobacco production. From careful surveys and estimates it is clear that more than 25 percent of Kentucky tobacco growers in 1945 adopted better work methods advocated by the Experiment Station. Increases of 25 to 30 percent in labor accomplishment through the improved work methods were general, and the saving to Kentucky farmers was at least 745,200 man-days of work—or, in terms of money, somewhat more than 3½ million dollars.

Opportunities for profit to farmers through the adoption of research findings, though not always so striking and direct as in the foregoing example, are implicit in many of the following brief reports of important investigations carried on by the Experiment Station in 1946.

[*See* "INDEX TO SUBJECT HEADINGS," *pages 66, 67, and 68.*]

Farm land values.— Farm land prices in Kentucky continued to rise in 1946, but with a tendency to level off in the latter half of the year. In four representative agricultural counties (Bourbon, Shelby, Daviess, and Simpson) the average increase in price of land during the year was 1 percent a month, and the average price for the year was 19 percent below the average in 1920, the peak year in the World War I period. In the four counties 11 percent more farms sold in 1946 than in 1945. From 1941 to 1945, the number of farms sold had increased at the rate of 21 percent a year. During each year (1941-46) about half as many farms were sold per year in the four counties as were sold per year in the World War I period. More than 60 percent of all transfers in 1946 were for cash—a higher proportion than in 1945. In the period 1917-20 only 30 percent of all transfers were for cash.

Success factors on 106 outstanding farms.— Businesses of 106 outstandingly successful farm operators in the better agricultural areas of Kentucky were studied during the year ending March 1946. Acre-yields of more than 60 bushels of corn, 4 tons of alfalfa hay, 2,000 pounds of burley tobacco, and correspondingly high yields of other crops were not uncommon on these farms. On many of the farms were mixed pastures with carrying capacity of 1 animal unit per acre. Abundant use of adapted certified seeds, application of large amounts of fertilizer and manure, turning under of cover crops, and normal applications of ground limestone were practices followed in obtaining the high production of crops and pasture.

Farms with high production, 150 to 300 tillable acres, and year-round employment for 3 to 5 farm workers (including the operator), generally had the greatest financial success—although some of the 106 farmers operated less than 100 tillable acres and had year-round employment for not more than 1 or 2 men, but were nevertheless very successful.

A large proportion of the 106 outstanding farmers had gross incomes of $100 or more per tillable acre, especially those operating relatively small farms. Tobacco sales usually amounted to 50 percent or more of the total income from sales of farm products. Prices received for burley tobacco per farm ranged from 40 to 50 cents a pound. Farm operating expenses usually equaled about half the gross income; labor cost, including cropper labor, was the largest operating expense item.

Most of the 106 farms had tractors and tractor equipment, especially those having 150 or more tillable acres. Tractors supplied most of the power used on the farms having tractors, and on the larger farms the use of tractors lowered production expenses considerably. Some of these mechanized farms had no work stock and many of them had only one or two head of work stock each.

The outstanding success of these 106 farms illustrates in practice

the results obtainable by adapting up-to-date scientific information on farm practices to the various tried-and-proved principles of good farm management—efficient utilization of farm labor and machinery, a good balance among the various high-return farm enterprises, a farm business of adequate size, and high production per acre of crops and per head of livestock.

Problems in marketing forest products in Eastern Kentucky.—Forests occupy about 70 percent of the land in Breathitt county and adjacent areas. The most valuable virgin timber was logged by large-scale lumbering companies between 1890 and 1924. The present timber includes residuals of low-value species and new growth of the more valuable kinds. Predominance of low-value timber in sparse stands, transportation difficulties, and relatively high operating costs, tend to make the Breathitt county and similar sections marginal-producing areas insofar as national markets are concerned.

The principal products of the cut-over hardwood forests of Eastern Kentucky are lumber, cross-ties, specialty logs, bourbon staves, and mine props. These products are sold largely to buyers in the primary hardwood markets and to buyers for local use. In marketing these products there are many problems, and the returns to the owners of timber are limited. This is true because, among other things, (1) small mills operating on sparse timber and on limited capital do not produce enough to encourage continuous or systematic marketing; (2) many operators of processing equipment do not have the ability and machinery necessary to produce well-manufactured products; and (3) the products offered, especially the lumber, do not sell well in competition with products from the large mills which are still cutting virgin timber in other parts of Eastern Kentucky and competing regions. The position can be improved by better processing so as to increase the value of timber locally, by a less costly system of handling and marketing, and by educational work and continuous guidance which will coordinate logging and marketing with sound forestry practices and management.

Breathitt county forestry demonstration.—In order to develop a pattern for more profitable management of forests in Eastern Kentucky, a forestry demonstration under the guidance of this Station was undertaken in Breathitt county. Voluntary groups were organized in 39 communities where forest holdings and farms are predominantly small, for protection of a forest area of some 259,600 acres. Two other communities in the county, characterized by large holdings, will remain within the protective system being developed by the state. In addition to direct work with these groups, the forester gave fire-prevention talks in 76 schools of the county. During 1945, while the forest protection associations were being organized, 50 known uncontrolled

fires burned over about 17,000 acres of woodland, roughly 5 percent of the county. This year, with some few communities still unorganized, 45 known fires burned over about 7,000 acres of woodland, about 2.2 of the county. Voluntary fire suppression was thus evidently much improved in 1946, despite the fact that 1946 was a more-dangerous-than-average fire year.

Farm woodland management plans are being made for properties which have been surveyed, and management demonstrations are being set up on as many of these farms as possible. Because the setting up of a woodland management demonstration often hinges upon the property owner finding a suitable market for his logs, the cooperation of mill operators has been sought and various services rendered to them, including assistance in obtaining mills, power units, repair parts, production problems, contracts, care of lumber on yard, and markets. Several operators expressed confidence in the program and willingness to cooperate in it. Eighteen of 74 owner plans begun were completed and delivered. Nine of the 18 property owners expressed a definite intention to cooperate further in a woodland management demonstration as soon as arrangements could be made to cut their timber. These properties total 1,339 acres. Two cooperators, with 426 acres, were going forward with woodland management demonstrations, and two others, owning 490 acres, had their demonstrations well under way and should complete their first cut early in 1947.

Although veneer logs are none too plentiful, a veneer company agreed to buy such logs if they could be assembled in carload quantities. This should stimulate greater cooperation between mill operators and also between timber owners. Various mines in the Hazard area were contacted to assist mill operators and property owners in disposing of mine props and timber to best advantage. In cooperation with the U. S. Forest Service a production survey was made of all mills located within the county. Contacts were made with the three nearest concentration yards to find a possible outlet for some forest products hard to move in less-than-carload quantities, and in rough form. Steps were taken by a Pennsylvania lumber company toward setting up a mill and concentration yard in Jackson. They expect to get under way early in 1947. Another company indicated that it would assist a local business man in starting a hickory handle factory in the county.

The rural church in Kentucky.— According to the 1936 Religious Census 85 religious bodies had one or more churches in Kentucky, 17 of these religious bodies being completely rural in their membership. Religious statistics also were obtained from the state or regional offices of the various denominations for 1945 or 1946. According to these there were approximately 1,300,000 church members in Kentucky, or 44 percent of the state's population. Four denomina-

tions—Baptist (Southern Convention), Catholic, Methodist, and Disciples of Christ—accounted for approximately three-fourths of the total church membership.

The proportion of persons members of a church varied considerably from one section of the state to another. The highest rate was in North Central Kentucky, an intermediate rate in Western Kentucky, and the lowest rate in Eastern Kentucky. The relatively low rate in Eastern Kentucky is accounted for partially by the fact that not all religious activities in this area are carried on through an organized church. Cities had a higher proportion of church memberships than rural areas.

Population in 5 magisterial districts, 1943 and 1946.— In 1943 the effect of war on rural population was studied in five selected magisterial districts in Kentucky—Carter county No. 6, Clinton county No. 3, Leslie county No. 3, Martin county No. 6, and Owsley county No. 2. In 1946 population was enumerated by interviewing neighborhood leaders in the same five districts. Only two of the five had recovered their wartime loss of population; in three there had been further decline since 1943. The two magisterial districts which had lost the most had recovered the most, and had made net gains since 1943. From the evidence in these areas it is apparent that it would be unwise for any one locality to assume either a great return of wartime migrants or continuing decline. The facts are different in different communities. In three of the districts in 1943 women outnumbered men; in 1946 there were more men than women in all five districts. Age distribution, unbalanced by a relative shortage of persons in the middle-age groups and a relative excess of aged persons in 1943, had changed little by 1946. Of the total population over 15 years old, 8.3 percent in 1946 were veterans, and about one-third of the men 15-34 years old were veterans. Out-migration had continued; of the 9,888 people residing in the five districts in 1943, 22.5 percent had migrated by July, 1946. Fewer than half of the out-migrants had moved to points farther away than an adjacent county.

Participation of rural people in organized activities.—Data on 2,832 adult residents in seven rural and two urban areas of Kentucky were analyzed for extent and nature of participation in organized voluntary activities and factors which promote or hinder such activities. Extent of education, economic and social position, length of residence in community, age, sex, and locality all were found to influence participation. College graduates had a rate of office holding in the voluntary organization 40 times as great as those with less than 4 years of schooling. Fifty-nine percent of persons with less than 4 years of schooling and 93 percent of all persons with a college education belonged to one or more organizations. Similarly, 56 percent of those

with annual income less than $500, but 92 percent of those with incomes of $2,500 or more, had membership in one organization or more. Persons aged 35 to 65 had highest rates of participation. Seventy-five percent of all women and 59 percent of all men were church members; 22 percent of all men but only 11 percent of all women belonged to other-than-religious organizations.

Important differences in participation were revealed among the various rural and urban areas in this study. In the two urban areas studied (Lexington and Jackson) only half as high a proportion of persons had no organizational memberships (17 percent) as in the seven rural areas (34 percent). In the urban sample 29 percent of the population belonged to other-than-religious organizations, as compared with 12 percent of the rural sample. Even more marked differences, however, were found among the rural groups themselves. For example, persons were almost twice as likely to have membership in a church and three times as likely to be members of other-than-religious organizations in the Central Bluegrass counties as in the Mountain counties.

These findings have several implications, but perhaps the most significant for the "organizational approach" to agricultural and other community problems is that a relatively high level of schooling appears to be necessary if there is to be widespread participation in voluntary organized activities.

Price differentials for slaughter hogs at several markets.— The difference in price paid for the same weight and grade of hogs at Louisville and at Cincinnati varied so much for different weight groups during the period 1937-41 that it was necessary to consider each weight group separately when comparing sales of hogs on the two markets. Good to choice barrows and gilts weighing 200-220 pounds averaged 30 cents per 100 pounds more at Cincinnati than at Louisville. Yearly averages ranged from 20 cents in 1940 to 37 cents in 1937. Heavy hogs, 240-270 pounds, averaged 32 cents per 100 pounds higher, and light hogs, 160-180 pounds, averaged 41 cents per 100 pounds higher at Cincinnati than at Louisville.

Louisville hog prices were below those at Cincinnati for all grades and weights for each month of the period covered by the study. For the 200-220 pound group the Louisville price averaged only 15 cents below the Cincinnati price during December and January, but the difference increased to 38 cents during May. The price of heavy hogs, 240-270 pounds, varied even more, the 5-year average January price at Louisville being 17 cents lower, but was 44 cents lower in April and May, and 48 cents lower in September than at Cincinnati. For lighter

hogs, 160-180 pounds, the differentials were wider but more uniform throughout the year, being narrowest in October at 34 cents and widest during April through July at 48 cents below Cincinnati prices.

Somewhat similar conditions prevailed between most of the other pairs of markets studied—Louisville and Bowling Green; Louisville and Nashville; Louisville and Evansville; and Cincinnati and Central Kentucky Auction Markets. These markets are all relatively close together, but relationships between Louisville and Chicago, a more distant market, were different. Although prices at both Louisville and Chicago are seasonally low during December and January, Louisville prices for the 200-220 pound group did not drop as far as at Chicago and during those months averaged higher. On the other hand, during the summer months, prices at Chicago rose more than at Louisville so that during this period Louisville prices averaged lower than those at Chicago.

In general, price differential patterns for all pairs of markets studied were sufficiently definite from year to year and from season to season to be used by farmers in making their production and marketing plans. There are, of course, many other factors that must be considered in choosing a market.

Price differentials for slaughter hogs of various weights at Louisville.— The relationship between prices paid at Louisville for hogs of the same grade but of different weights varies considerably from year to year. Annual average price differentials showed that hogs weighing 240-270 pounds sold for 20 cents (in 1937) to 43 cents (in 1941) below those weighing 200-220 pounds while hogs weighing 140-160 pounds sold for 34 cents (in 1938) to 98 cents (in 1940) below the 200-220 pound group. Prices paid for hogs weighing 180-200 pounds differed very little from those paid for hogs weighing 200-220 pounds.

There are distinct seasonal patterns in the differentials between prices paid for the various weights of hogs. The pattern of the differential between the heavyweight group, 240-270 pounds, and the 200-220 pound group was different from those between the 200-220 pound group and either of the groups weighing below 180 pounds. The price spread between the 200-220 pound group and the heavyweight group, 240-270 pounds, narrowed during the first five months of each year selling closest in May, widened rapidly during the summer, and then narrowed again during the fall months. The lightweight groups, below 180 pounds, had a widening differential from January to late summer, and then narrowed sharply during the remainder of the year. The widest spread occurred in July and August, and the narrowest in December.

These data indicate that there is a rather definite annual pattern in prices paid for hogs of the various weight-groups and that this pattern is closely tied up with the hog production and price cycles. When hogs are plentiful and prices low, as in 1940, the spread between prices of the desirable slaughter-weight hogs and those of less desirable weight is much wider than during the period when hog numbers are low and prices are high, as was the case in 1938.

Distillers' corn dried solubles for pigs.—In previous tests distillers' dried solubles showed up so unpalatable as to require being fed with some other protein supplement for best results with hogs. The two tests summarized here were planned accordingly. The pigs were self-fed yellow corn and a mineral mixture of 4 pounds of fine-ground limestone and 1 pound of salt. Lot 1 was self-fed a protein supplement mixture made of 50 pounds tankage or meat scraps (meat scraps in the first test and tankage in the second) 25 pounds soybean oilmeal, and 25 pounds ground alfalfa hay. This lot was used as the check lot. Lot 2 was self-fed a similar mixture in which the soybean oilmeal was replaced by the same weight of distillers' corn dried solubles. Lot 3 was self-fed a mixture of 80 pounds of soybean oilmeal and 20 pounds of distillers' corn dried solubles. Lot 4 was self-fed a mixture of 50 pounds of tankage or meat scraps and 50 pounds of distillers' dried solubles. The average results for both tests were as follows:

	Lot 1 lb	*Lot 2* lb	*Lot 3* lb	*Lot 4* lb
Average daily gain	1.74	1.69	1.69	1.71
Amount feed per 100 lb gain				
Corn	307.8	294.3	269.5	289.0
Protein supplement	47.5	59.8	65.9	60.9
Mineral supplement	.5	.6	.6	.6
Total feed	355.8	354.7	336.0	350.5

These tests show that distillers' corn dried solubles can be used effectively as a protein supplement and drylot rations for fattening hogs, in any of the combinations tried.

Yellow shelled corn versus "sweet feed" for creep-fed suckling lambs.— Suckling spring lambs creep-fed yellow shelled corn to an average age of 100 days ate 17.5 percent less grain, gained 2.1 percent faster, and graded very slightly higher in finish than similar lambs creep-fed a "sweet feed" composed of 800 lb crushed oats, 730 lb cracked corn, 200 lb wheat bran, 100 lb linseed oilmeal, 150 lb molasses, and 20 lb iodized salt.

Continuous versus rotational grazing for unweaned spring lambs.— Eight unweaned spring lambs that grazed with their dams continuously on a 3.45 acre field of bluegrass gained 30.7 percent

faster than eight comparable lambs that grazed with their dams on three adjacent 1.15 acre fields in rotation at 2-week intervals. The very small difference in finish of the two groups was in favor of those grazed rotationally. In ten previous tests there had been a 3.7 percent average advantage in rotational grazing.

Alfalfa, bluegrass, and corn silages for pregnant and lactating ewes.— Four comparable lots of 10 western grade ewes each were fed in drylot from November 30 to April 19, a period of 140 days. Each ewe in lot 1 received 4 pounds of "U.S. No. 2 plus" alfalfa hay per day and each ewe in lots 2, 3, and 4 was fed 1.2 pounds of the same alfalfa hay per day plus enough alfalfa, bluegrass, or corn silage, respectively, to supply 2.12 pounds of dry matter. The ewes in lots 1, 2, and 3 were fed ½ pound of yellow shelled corn per head daily before lambing and 1 pound daily after lambing. The lot 4 ewes received no corn but got 1/5 pound of soybean oilmeal per head daily, because of the high carbohydrate but low protein content of the corn silage. Salt, steamed bonemeal, and fine-ground limestone were self-fed separately.

When the number, birth weight, strength at birth, and gain of lambs, as well as fleece weight and gain of ewes, were all taken into consideration, the lots rated as follows, from best to poorest: bluegrass silage, alfalfa silage, alfalfa hay, corn silage. The differences, however, were quite small.

Shelled corn versus "sweet feed" as a winter concentrate for pregnant and lactating ewes.— Twenty pregnant mottled-face western ewes were divided into two similar lots on November 30 and fed in drylot until April 19, a period of 140 days. Each ewe in both lots received, daily, 4 pounds of "U.S.No. 2 plus" alfalfa hay, together with ½ pound of grain before lambing (88 days) and 1 pound of grain after lambing (52 days). The grain fed the lot 1 ewes was shelled corn whereas the grain fed the lot 2 ewes was a "sweet feed" composed of cracked corn 730 pounds, crushed oats 800 pounds, wheat bran 200 pounds, linseed oilmeal 100 pounds, molasses 150 pounds, and iodized salt 20 pounds. No appreciable differences were noted between the lots in gain, fleece production, condition of the ewes, or in the number, strength, birth weight, or gains of their lambs.

Pasture for finishing late lambs.— Fifty weaned and shorn late lambs averaging 55 pounds in weight on June 14, the start of the experiment, were divided into five uniform lots and grazed until October 18, a period of 126 days. Four of the lots grazed on bluegrass, soybeans, lespedeza, and ladino clover, respectively, without grain. The fifth lot grazed on bluegrass but was also fed an average of 0.88

pound of yellow shelled corn per lamb per day. All lambs had access to an abundance of their respective forages plus shade, water, and a 9:1 salt-phenothiazine mixture. In gain produced, the forages ranked as follows, from best to poorest: lespedeza, ladino clover, bluegrass with corn, soybeans, and bluegrass without corn. In average live grade at the end of the test the ranking was ladino clover, bluegrass with corn, lespedeza, soybeans, and bluegrass without corn.

Relative performance of lightweight and of heavier mottled-face western ewes.— Production data were obtained for the second year on five lots of mottled-face western ewes, whose average weight as yearlings last year at breeding time ranged from 75 to 144 pounds per head. As in their first year of production, the next-to-the-heaviest group produced the earliest, heaviest, and most lambs, and the heaviest fleeces. The ewes of this size sheared fleeces averaging 1.81 pounds heavier than the lightest ewes and their lambs gained nearly one-fourth faster. At prevailing market prices, the second year's production of wool and lambs by this next-to-the-heaviest lot exceeded that of the lightest lot by about $6 per ewe.

Digestibility and palatibility of Korean lespedeza, Ky 31 fescue, and orchard grass for grazing lambs.— In digestion and consumption studies with six 70-pound wether lambs in midsummer of 1946, Korean lespedeza excelled both Kentucky 31 fescue and orchard grass in digestibility of dry substance and in palatability. Digestion coefficients for dry matter obtained during two separate periods in late July and in early August were as follows: Korean lespedeza 57.09 and 59.41 percent, Kentucky 31 fescue 53.29 and 41.29 percent, orchard grass 49.21 and 37.33 percent. Daily intake of dry substance ranged from 0.95 pound per day for one lamb on orchard grass to 2.32 pounds per day for a lamb grazing on Korean lespedeza. This latter intake is considered to be a full feed for a lamb of this size.

Survival of nematode parasites of sheep on pasture.—Two weeks of exposure on a plot of permanent pasture 3 months after contamination with ova of *H. Contortus, O. circumcincta, Trichostrongylus spp., N. filicollis,* and *O. columbianum* failed to establish infestation in a parasite-free lamb, with any of this group of parasites. Larvae from the worm eggs evidently failed to survive the three-months exposure from July 1 to October 1, or were so reduced in number that infestation of the lamb did not occur.

Penicillin dosage and blood levels for sheep and calves.— Serum-level response following intramuscular injection of saline containing 5,000 units per millimeter, was determined in sheep and calves. In dairy calves doses of 300 units per pound maintained a

detectable quantity (0.015 unit per milliliter) of penicillin in the serum for one hour, but not for 2 hours, in each of four trials. In one trial, a dose of 375 units per pound maintained a measurable serum level for 1 hour. Doses of 500 units per pound produced serum concentrations which persisted in measurable quantity for 1 hour in one trial, for 2 hours in two trials, and 2½ hours in one trial.

In sheep, a detectable serum concentration following doses of 300 units per pound was maintained for 2 hours in two trials, for 3 hours in three trials, and for 4 hours in one trial. With doses of 500 units per pound a measurable serum level was maintained for 4 hours in each of seven trials.

Water-in-oil vehicle for penicillin.— Material for intramuscular injection was prepared by dissolving 100,000 units of penicillin in 1 milliliter of physiological saline and emulsifying this solution in four milliliters of U.S.P. peanut oil containing 2 percent U.S.P. white wax. Persistence of a measurable serum level following intramuscular injection of penicillin in the water-in-oil emulsion was determined in horses and sheep. In horses, a dose of 500 units per pound maintained a detectable quantity of penicillin in the serum for 3 but not for 4 hours in each of four trials. With sheep, a dose of 500 units per pound resulted in blood concentration which persisted in detectable quantity for 4 hours in two trials and for 5 hours in two trials.

Reducing time and labor in dairy-herd chores.— A job analysis study of the time, motion, distance traveled, and equipment used in the chores for a herd of 28 dairy cows was made in the spring of 1944, and recommendations were made for improvement. In the spring of 1946 another analysis was made of the same herd. A reduction of 40 percent had been made during the two years in time required to grain-feed, place cows in barn, prepare for milking, milk, and return the cows to the lot. Milking time per cow was reduced from 5.39 minutes per milking per cow to 3.14 minutes. Better work routines in feeding, washing udders, strip testing, and stripping saved 4.34 minutes of man labor per cow per milking and reduced the number of milking units by 50 percent. Travel was reduced 50 feet per cow per milking—a saving of approximately 200 miles of walking per year for a herd of 28 cows—and use of fewer milking units made a reduction of $3.10 per cow in the annual equipment cost.

Yield of bluegrass pasture under alternate and under continuous grazing by dairy heifers.— During the 210-day 1946 pasture season temperature was moderate and rainfall adequate and well distributed. The pasture yield (average of the two halves of the pasture) was 2,620 pounds of total disgestible nutrients per acre as calculated

from gains of the heifers—about 15 percent above the 11-year average. This yield was equivalent, in total digestible nutrients, to a yield of 58.2 bushels of corn per acre.

When this experiment was begun in 1936 the pasture plot selected was divided into two halves of equal productivity, so far as could then be ascertained. For 8 years thereafter the eastern half was grazed alternately and the western half continuously, by dairy heifers, during the pasture season. Results during those 8 years indicated a superiority of alternate grazing over continuous grazing. Beginning in the 9th year, however, the grazing practices were changed, the eastern half being grazed continuously and the western half alternately. Results during the succeeding three years, contrary to the preceding indications, have favored continuous grazing. It is now clear that the differences formerly attributed to differences in method of grazing have been due chiefly if not entirely to a difference in the productivity of the two halves of the pasture. On an average, the eastern half of the pasture has yielded about 5 percent more total digestible nutrients than the western half, regardless of method of grazing used. This year the heifers on the eastern half, grazing continuously during the season, made larger gains (403 pounds per acre) than those grazing alternately on the western half (367 pounds per acre). Taking into account the evident difference in productivity of the two halves of the pasture, little if any advantage can be claimed for either method of grazing.

Artificial insemination program.—The Kentucky Artificial Breeding Association was organized in February, 1946, made up of four local cooperatives. Five acres of land were purchased and a central bull stud barn and laboratory built. A number of bulls were purchased or leased, and the first semen shipments were made on September 17 to four local cooperatives whose membership totalled 462 herd owners with 5,063 cows signed up for service. In October and November, four additional local cooperative associations were organized bringing the total membership to 1,173 herd owners with 10,223 cows signed up.

At the time of first shipment of semen 13 sires were being used at the central stud. Altogether, 23 sires were used up to November 30, 1946; 6 were discarded chiefly because of low fertility.

In September, 179 cows were bred for the first time, in October, 538 and in November, 634. Based on 30-60 day reports of nonreturns, 49 percent of the September first services resulted in conception, and 53 percent of the first services in October resulted in conception.

This project is beginning to accomplish its objectives (a) to distribute widely the choice germ plasm of a few carefully chosen sires, and (b) to make superior sires available to many small herds in Kentucky.

Detection and measurement of ovulation potentials in farm animals.— An apparatus has been completed and used in tests at this Station to determine, electrically, the time of ovulation in farm animals. The chief problems which arose in the testing of large animals were: (1) Complete electrical insulation from the ground, accomplished by the construction of a suitable stanchion. (2) The devising of electrodes through which electrical contact could be established with the animal tissues. Those obtained from investigators in a related field were not entirely satisfactory. Appropriate modifications were planned in cooperation with other workers. (3) Fnding the most effective points of contact. Further testing in this regard may be necessary.

After slight modification of equipment numerous animals will be tested in routine fashion to learn more about ovulation phenomena in relation to conception rate.

Digestibility and palatability of Ky 31 fescue, orchard grass, and Korean lespedeza for grazing steers.— In digestibility and palatability trials during July and August with 1 steer on Ky 31 fescue, 2 on orchard grass, and 1 on lespedeza, Ky 31 fescue was slightly more digestible but somewhat less palatable than either orchard grass or late Korean lespedeza.

Distillers' corn dried solubles as a protein supplement for fattening steers in drylot.— Two similar lots of 10 "U.S.Good to Choice" yearling Hereford steers were fed in drylot for 112 days. Each steer in both lots was fed daily an average of 9.7 pounds of low-grade alfalfa-molasses silage, 15.4 pounds U.S.No. 2 yellow shelled corn, and 2.4 pounds of wheat straw. Fine-ground limestone, salt, and water were available at all times. Each steer in lot 1 also received daily 1.4 pounds of soybean oilmeal testing 40.8 percent crude protein, and each in lot 2 received daily 1.9 pounds of distillers' corn dried solubles testing 20.5 percent crude protein produced from a mash containing 65 percent yellow corn, 23 percent rye, and 12 percent barley malt. The steers in lot 1 gained an average of 2.87 pounds per steer per day, whereas those in lot 2 gained an average of 2.67 pounds. The solubles fed in this experiment were unusually low in crude protein content.

Digestibility by steers of similar rations containing hydraulic- and solvent-process cottonseed meal.—Three Hereford yearling steers in feeder flesh and averaging about 850 pounds weight were fed for a 5-day preliminary period and an 8-day collection period on a daily ration composed of 11 pounds of cracked yellow shelled corn, 4 pounds low-grade alfalfa hay (9.3 percent crude protein) and 1.3 pounds of 41-percent hydraulic process cottonseed meal. During a succeeding and similar digestion trial, the same three steers were fed on

the same ration except that the hydraulic-process cottonseed meal was replaced with an equal weight of 41-percent cottonseed meal produced by a new solvent-extraction process. By chemical analysis the meal produced by the hydraulic process contained 40.4 percent crude protein, 5.3 percent ether extract ("fat"), 9.6 percent crude fiber and 32.8 percent nitrogen-free extract; and that produced by the new solvent process contained 40.9 percent crude protein (after addition of a calculated amount of hull bran to reduce the protein content), 3.5 percent ether extract, 9.3 percent crude fiber, and 33.9 percent nitrogen-free extract. The average digestion coefficients for dry substance, protein, fat, fiber, and nitrogen-free extract were, for the ration containing the hydraulic-process meal 72.86, 57.17, 78.01, 51.99, and 77.92 percent, respectively; and for the ration containing the solvent-process meal 75.94, 60.60, 76.36, 56.26, and 81.84 percent.

Fetuses and foals.— Postmortem examinations were made on 71 fetuses and 65 foals during 1946. Eleven abortions, 12 less than in 1945, were diagnosed as equine virus abortion. Streptococci were isolated from 12 fetuses, 13 were twin abortions, and the cause of abortion was not determined in 29 cases. Four of the remaining 6 were due to abnormal development, and 2 to staphylococci and *Escherichia coli*.

Streptococci were isolated from 17 foals, *Shigella equuli* from 11, and *E. coli* from 8. The cause of death was not determined in 15 foals. Postmortem examinations of the remaining 14 cases revealed *Salmonella typhi-murium* (2), *Corynebacterium* equi miscellaneous bacteria (2), dystocia (3), traumatism (3), abnormal development, virus abortion and jaundice. Anaerobic cultures were made at all postmortem examinations as a routine procedure without markedly changing the results on bacterial isolation although in one instance an anaerobic streptococcus was obtained.

In further studies on the evaluation of equine virus abortion liver-extract vaccine, 518 mares were vaccinated in the fall of 1946.

Analysis of normal Thoroughbred horse blood.—Analyses have been made of the blood of 60 normal Thoroughbred weanlings from 3 stud farms near Lexington. The age of the weanlings ranged from 149 to 239 days, and averaged 187 days. All analyses except those for magnesium were made on serum by the usual clinical methods. For magnesium the method developed by Weeks and Todd was adapted for use with blood serum. Phosphatase is reported in Bodansky units, where 1 unit is equivalent to 1 mg of phosphorus liberated from beta-glycerophosphate in 1 hour incubation at 37° C. The average results per 100 ml were calcium, 14.00 mg; inorganic phosphorus, 5.92 mg; Ca/P ratio, 2.39; magnesium, 2.66 mg; alkaline phosphatase, 20.4 units; acid phosphatase, 0.43 units.

Salmonella and paracolon bacteria.—Of 2,231 cultures examined 1,488 were from animals, 53 from animal food products and 690 from man. Of these, 1,309 cultures from animals, 51 from food products, and 520 from man were *Salmonella* and were identified serologically. Four new types, *S. luciana* (XI:a-e, n, z_{15}), *S. daytona* (VI, VII:k-1,6), *S. richmond* (VI,VII:y-1,2,3) and *S. tallahassee* (VI,VIII:z_4, z_{32}) were found, and formulas of 6 new types were confirmed for other workers. *S. pullorum* was again found in intestinal infections of man. Cultures of *S. panama, S. oregon,* and *S. javiana* which produced indol were noted. Certain nonmotile *Salmonella* cultures were found to contain flagellar antigens and well-developed flagella were demonstrated in these nonmotile forms.

Monophasic variants of diphasic *Salmonella* types were studied. These proved to be excellent cultures for preparation of specific diagnostic serums. In many instances, 2 stable phases were isolated from the same cultures by induced variation. This greatly simplified the production of many diagnostic serums.

The Arizona group of paracolon bacteria were classified by antigenic analysis. Twenty-one somatic groups and 55 types were found among 500 cultures examined. The serological types proved to be epidemiologically significant and it was only through serological typing that it was established that these paracolon bacteria are capable of causing severe and fatal infections in man and animals. This is the first instance in which paracolon bacteria have been successfully classified and proved to produce disease.

Salmonella abortivo-equinus vaccine.—Vaccine was prepared in the Experiment Station laboratories for immunizing 1,802 mares, on 62 farms, against Salmonella abortivo-equinus.

Aspergillosis in chicks.—Mycotic pneumonia due to *Aspergillus fumigatus* was observed in 3 flocks of chicks ranging in age from 2 to 4 weeks. In one flock the source of infection was moldy feed and in the other two moldy straw used for bedding. Morbidity in the flocks ranged from 30 to 40 percent and deaths averaged about 10 percent. Incidence of new cases subsided after removal of the moldy feed and straw. Most of the affected chicks recovered slowly. The mold was isolated in cultures and identical disease was produced in experimental chicks by intratracheal inoculation with pore suspensions.

Newcastle disease.—The virus of Newcastle disease was isolated in September, 1946, from a group of chicks near Lexington, and it was established that the serum of adult chickens in contact with these chicks contained neutralizing antibodies for this virus. Later the presence of Newcastle disease virus was recognized in another group of chicks in Kentucky, through serum-neutralization tests. Two

more suspected outbreaks of Newcastle disease were investigated without detecting the presence of the virus.

Control of poultry lice.— Sodium fluoride powder, 3-percent DDT dust, and 40-percent nicotine sulfate (drop method) were compared for control of body lice on heavily infested hens, and especially for killing louse eggs or young lice hatching from eggs after treatment. On retreatment of all hens with 40-percent nicotine sulfate (drop method) 3 weeks later, no lice of any size were found on any of the hens except one body louse on a hen originally treated with 40-percent nicotine sulfate. These tests suggest that repeating the treatment a week or 10 days later, as is usually suggested, is unnecessary when the first treatment is highly effective.

Vegetable protein for growing pullets.— Previous results have shown that soybean oilmeal may be used to replace animal sources of protein in the ration of growing pullets, if properly supplemented by green pasture and a source of phosphorus such as steamed bonemeal. In further trials along this line, distillers' wheat dried solubles was not as satisfactory as animal protein sources when used as the sole source of protein in the growing ration, even when supplemented with green pasture and steamed bonemeal. A combination of distillers' wheat dried solubles and meat scrap gave excellent results during the growing period when supplemented with pasture and steamed bonemeal.

Succulent pasture and bluegrass silage for laying hens.—Bluegrass pasture growing in the spring or fall, succulent Korean lespedeza or alfalfa pasture in summer, and growing rye pasture or bluegrass silage in winter were given 1-year-old Rhode Island Red hens as supplements to an all-mash laying ration. Consumption of young, growing bluegrass in the spring was materially larger than consumption of mature bluegrass in summer, and saved about 20 percent of an all-mash ration. Substitution of growing Korean lespedeza or alfalfa pasture for mature bluegrass pasture in summer saved about 12 percent of the all-mash ration, as did fall-growing bluegrass pasture which was actually higher in protein than that which grew in the spring. Rye pasture saved less than 10 percent and succulent bluegrass silage fed free choice saved about 12 percent of the all-mash ration during late December, January, February, and early March. Neither the pasture nor the bluegrass silage had any apparent effect on the number, size, or hatchability of the eggs laid, but in all instances hens that had pasture or silage laid more eggs than those that did not have it.

Effects of ration on composition of hen eggs.—Four lots of Rhode Island Red hens were fed 4 different all-mash rations, alternated from time to time. Ration 1 was a complex ration in which

vegetable protein was in excess of animal protein. In ration 2 vegetable protein was largely replaced by skimmilk protein, the starch content being retained by increasing the quantity of corn from 57.5 to 70.25 percent. Ration 3 was the same as ration 2 except that 17 percent of corn was replaced by 17 percent of corn oil; and ration 4 was the same as ration 2 except that the corn was replaced by 17 percent of soybean oilmeal (41 percent protein). Starch content in ration 3 was practically the same as in ration 4, but was about 11 percent less in rations 3 and 4 than in rations 1 and 2. Fat content of ration 3 and protein content of ration 4 were larger than the fat and protein content of the other rations. To balance the percentages of calcium and phosphorus, rations 2, 3, and 4 contained 1.5 percent more steamed bonemeal and 0.5 percent less limestone than ration 1. There were no significant differences in feed consumption by the hens on the four rations, nor any material differences in the average weight of the daily droppings in the four lots.

The average number and weight of eggs laid was practically the same for all the rations. There were significant differences in average weight of wet yolk, dry yolk, dry shell, and in yolk color, in the four lots. A material increase in average weight of eggs from the hens when the experimental rations were fed, was caused by increase in average weight of the white.

Replacing most of the vegetable protein by animal protein (skimmilk) lowered the iodine number and refractive index of yolk fat. Replacing 17 percent of the corn by 17 percent of corn oil did not change the iodine number but raised the refractive index of yolk fat from 1.4620 to 1.4636. Replacing 17 percent of corn or corn oil by 17 percent of soybean oilmeal (41 percent protein) lowered the iodine number and raised the refractive index of yolk fat. There was a considerably larger percentage of fat in the droppings from the hens which received corn oil.

Containers in use in freezing eggs.—In an investigation of effect of container on frozen eggs for cooking, whole eggs, egg yolks, and egg whites only were put in containers made of glass, cellophane, cardboard, lacquered tin, plain tin, and plain tin with a thin coat of paraffin on the inside. Four lots of egg yolks in each type of container were frozen—(1) yolks with nothing added, (2) salt added, (3) glycerine added, (4) syrup added. The additions were made to note what effect they would have, if any, in preventing the jellation of egg yolks by freezing. As whole eggs and egg whites do not congeal when frozen, no additions were made to them.

One lot was tested after being frozen 6 weeks. The frozen eggs to be tested were removed from the locker and kept at 54° F in a refrigerator until used for baked custards and angel food, sponge, and

butter cakes. The products were scored by eight judges, the majority of whom were experienced from previous like tests. Each series of products was compared with a standard made from fresh eggs.

Whole egg and egg white frozen in containers of glass, lacquered tin, plain tin or plain tin with a thin coating of paraffin and stored 6 weeks were as satisfactory as fresh eggs for use as a thickening agent as in custards and as a leavening and thickening agent as in cakes. Egg yolks, however, had to have something added to them to prevent their congealing, if they were to compare favorably with fresh eggs. In these tests salt seemed most desirable as an antijellation substance. Glycerin was excellent except in the custards, when the foam produced from beating the egg yolk did not subside as in the other custards but remained about an inch deep, resulting in an undesirable too-browned top. Frozen egg yolk with nothing added to prevent congealing made less desirable custards than other egg yolks. The custards with salt added to the yolk were judged somewhat low on flavor. Some of the custards made from eggs stored in cardboard were judged low because of a "waxy" flavor. Eggs stored in cellophane or cardboard and used in cakes were judged consistently less desirable than the eggs stored in the other containers.

Effect of roasting and reheating on the riboflavin content of turkey.— In further studies on the effect of roasting on the vitamin content of turkey, analyses of riboflavin were made on raw and roast portions of turkey. This investigation was continued as a part of the national cooperative project on conservation of the nutritive value of turkey and is a continuation of a study on Broad-Breasted Bronze turkeys on which the thiamine content of turkey cooked by institution methods was reported.

The procedures were the same as those described for the analyses of thiamine. Raw liver contained more riboflavin than any of the other portions of the turkey analyzed. Liver contained 75 times more riboflavin than skin and 10 times more than dark meat. Raw and roast gizzard contained one-fifteenth as much riboflavin as raw and roast liver. Drippings were low in riboflavin. Dark meat contained more riboflavin than white meat. Gizzard and dark meat have approximately twice as much riboflavin as white meat and skin.

Less destruction of riboflavin than of thiamine occurred during the roasting of the turkey. The sample of raw white meat cut from just underneath the skin averaged 189 micrograms percent. The comparable portion of white meat removed immediately after roasting averaged 128 micrograms percent. The remaining white meat was sliced from the roast turkey after it had been cooled 24 hours. The slices were divided into 3 lots that contained as nearly as possible like amounts of samples beginning with the slice next the outer one

already removed and going inward to the slices next to the bony framework. Lot I had an average of 144 micrograms percent. Lot II, which was reheated on a steam table for 20 minutes, had 142 micrograms percent and lot III, which was reheated for 50 minutes, averaged 145 micrograms percent. Paired raw portions had an average of 147, 175, and 175 micrograms percent respectively.

The dark meat removed for analysis immediately after roasting, and which like the white meat was just underneath the skin, averaged 278 micrograms percent of riboflavin. The paired raw sample averaged 431 micrograms percent. The roast dark meat analyzed after it had cooled 24 hours, after cooling for 24 hours and reheating for 20 minutes on a steam table, and after cooling for 24 hours and reheating for 50 minutes, averaged 337, 330, and 304 micrograms percent respectively. Paired raw samples gave average values, respectively, of 450, 500, and 486 micrograms percent. These three values, as well as those of comparable values of white meat, are higher than those found in the samples taken immediately after roasting but less than in the raw samples.

An average serving of white meat of turkey would supply 1.9 to 2.4 percent of the recommended allowance of riboflavin. The dark meat would supply 4.4 to 5.3 percent.

Yields of corn, wheat, and hay on soil experiment fields.— The value of limestone and fertilizer treatments in a good cropping system is shown by the following yields, averages for 1946 at the experiment fields at Berea, Fariston, Greenville, Mayfield, and Campbellsville:

Treatment	*Acre-Yields*		
	Corn bu	*Wheat* bu	*Hay* lb
No treatment	15.4	2.2	1466
Manure	42.6	4.8	2138
Manure, superphosphate	60.6	11.8	3578
Manure, rock phosphate	72.5	15.7	4724
Manure, limestone, superphosphate	70.4	15.7	4837
Manure, limestone, rock phosphate	77.5	16.3	5370
Manure, limestone, superphosphate, potash	70.8	16.4	5417

Without treatment all these soils are deficient in phosphorus and too acid to grow clover and alfalfa successfully. In management of the fields, manure has been applied for corn in amount equal to the total weight of the crops of the rotation (wheat grain excepted) harvested the preceding year. Limestone was applied, 4 to 6 tons per acre, at all fields before 1923, and again at 1 ton per acre at Berea between 1928 and 1930 and at Greenville between 1942 and 1945. The need

for reliming at the other fields is not yet apparent. Since 1939 superphosphate (20-percent equivalent) has been used at the rate of 100 pounds per acre per year and raw rock phosphate at the rate of 125 pounds per acre per year. Before 1939 (except for the first 2 rounds of the rotation) superphosphate was used at the rate of 100 pounds of 16-percent per acre per year, and raw rock phosphate 200 pounds. During the first two rounds the rates were 200 pounds superphosphate and 400 pounds raw rock phosphate.

Radioactive fertilizer for field crops.— Favorable effects of radioactive compounds, used with fertilizers, upon the yield and quality of truck crops, have been reported by investigators elsewhere. Field tests on corn and wheat at the Lexington farm were run in 1946, using radioactive material. The suggested rates of 2 grams and 4 grams of the material per square yard were used in mixture with a complete fertilizer broadcast and disked into the soil. In triplicated tests on Maury silt loam there was no appreciable effect on quality or yield of wheat grain from either rate of application, and in tests with corn on Burgin silty clay loam, replicated 6 times, there was likewise no significant effect on yield or quality of corn.

Residual phosphorus in soil after heavy applications of rock phosphate and superphosphate.— At the Campbellsville Experiment Field, 900 pounds of 16-percent superphosphate and 1,800 pounds of 32 percent raw rock phosphate per acre were applied once in each 3-year rotation of corn, wheat, and clover, from 1919 to 1930, inclusive. The P_2O_5 applied during the 4 rounds of the rotation amounted to 576 pounds per acre on the superphosphate plots and 2,304 pounds per acre on the rock phosphate plots. The cost of the two treatments was about the same. To study the effect of the residual phosphate following these rather heavy applications, the application of phosphate was discontinued after 1930. Some of the plots had been limed at the rate of 2 tons of limestone per acre twice between 1919 and 1924. This amount of limestone greatly decreased effectiveness of the rock phosphate on this soil and the ill effect did not disappear until about 1931.

The average increases in yield over the untreated plots, are shown in the following table for the fourth round of the rotation (just before discontinuance of the phosphate applications) and for the ninth and most recent round of the rotation, 15 years after the discontinuance of phosphate applications.

	Yield Increases over Checks			
	Sp (900 lb)	*Rp (1800 lb)*	*LSp (900 lb)*	*LRp (1800 lb)*
Corn (bushels per acre)				
4th rotation (1927-29)	19.3	20.7	23.7	12.4
9th rotation (1943-45)	14.4	26.8	15.8	29.0
Wheat (bushels per acre)				
4th rotation (1929-31)	9.7	10.7	10.9	8.9
9th rotation (1944-46)	5.1	11.4	6.0	10.5
Mixed hay (pounds per acre)				
5th rotation (1930-32)	1003	1225	1689	1563
9th rotation (1944-46)	744	1928	863	2661

After the applications were discontinued, yield increase from superphosphate became considerably less on both the limed and unlimed plots but was very much greater from rock phosphate than from superphosphate, especially on the limed plots. However, because 4 times as much phosphorus was applied in rock phosphate as in superphosphate, the after-effect from the rock phosphate should be better than that from the superphosphate. This is further shown by chemical analysis of the soil. Samples taken in 1938 and 1946, after the 6th and 9th rotations, were analyzed for phosphorus soluble in 1/20 normal sulfuric acid. The results showed an appreciable decrease in soluble phosphorus during this period. The increase in soluble phosphorus over that of the check plots had fallen from 30 to 16 pounds per acre in the unlimed superphosphate plots, and from 32 to 22 pounds in the limed superphosphate plots. In the rock phosphate plots it had fallen from 520 to 386 pounds per acre in the unlimed and from 622 to 476 pounds in the limed plots. These results are not closely related to yield of crops but they show the extent to which the residual phosphorus is being used and why results with rock phosphate were better than with superphosphate.

Deficiency of phosphate and potash in soils of Kentucky.— Deficiency of available phosphate and potash, one or both, in many soil samples tested from farms over the state, indicates great need for application of both these plant foods, for production of good crops. Of 686 samples from farm fields tested in 1946, 53 percent had too little available phosphate for production of good tobacco, and 34 percent had too little for production of good pasture or grain crops. Available potash was low in 53 percent. Of the soils high in phosphate, 53 percent tested too low in available potash for good growth of tobacco or alfalfa and 39 percent too low for good growth of pastures or corn. There is thus a tendency toward low available potash in high-phosphate soils. Much of this could be remedied by careful utilization of farm byproducts such as farm manure and tobacco stalks, both good farm sources of potash.

Effect of drilling fertilizer in contact with the seed, on stand and yield of wheat.— In a test at the Lexington farm begun in the fall of 1945, complete fertilizer (4-8-6) or straight superphosphate drilled in contact with wheat seed at the very heavy rates of 1200 and 1500 pounds per acre greatly retarded germination and emergence of the seedlings, and resulted in somewhat thinner stand in the fall than the wheat of adjacent plots without fertilizer. However, because of somewhat less winterkilling and greater tillering, wheat on the heavy fertilized plots had almost as good stand in early March as that on the unfertilized plots. Grain yields for the heavy rates of complete fertilizer was appreciably better than that on the unfertilized controls, and about as good for superphosphate.

The same fertilizer drilled in contact with the seed at 600 pounds or less per acre caused little or no reduction in stand, in comparison with the unfertilized wheat, and the yield of grain was only slightly better than the controls. The tests were on highly fertile Maury silt loam.

Form of phosphorus in corn grain and stover.— In corn grown on the soil-fertility plots of the Campbellsville Experiment Field in 1945, about 5 percent of the phosphorus in the grain was inorganic, 2.5 to 4.5 percent was in phospholipids, 78 to 84 percent in phytin, and 9 to 12 percent in mucleoproteins or nucleic acids. Thus it appears that 85 to 90 percent of the phosphorus in corn grain is in the nonvital parts of the seed, mostly endosperm, and a very constant amount is in the embryo. In stover about 40 percent was inorganic, 3 percent was in phospholipids, 9 to 20 percent in acid-soluble organic compounds, and 40 percent in nucleo-proteins. The acid-soluble organic fraction was not studied.

Form of phosphorus in corn in relation to phosphate supply in the soil.— Use of phosphate fertilizer greatly increased the phosphorus content of corn grown on some of our important soil types. At Campbellsville (Pearman silt loam), phosphate fertilizer increased the phosphorus content of grain 25 to 55 percent, and that of stover 30 to 93 percent, depending on the amount and kind of fertilizer. Most of this increase in phosphorus content of grain was in the phytin fraction, the storage form in the endosperm. None of the other fractions was consistently affected. In stover most of the increase was in the inorganic fraction and in the residual or mucleoprotein fraction.

There was a consistent increase in total phophorus in grain and stover and in phytin phosphorus in grain and inorganic phosphorus in stover with increased phosphorus availability in the soil. "Acid-soluble phosphorus" in the following table was determined with N/20 sulfuric acid.

Treatment	Acid-Soluble Soil Phosphorus	Phosphorus in Phytin in Grain	Inorganic Phosphorus in Stover
	ppm	%	%
No treatment	6	.134	.027
Manure alone	10	.168	.024
Manure and superphosphate	30	.189	.026
Manure and rock phosphate	293	.262	.055

Fertilizer tests on corn on overflow land.—In 1946, 17 fertilizer tests were made to determine the effect of different fertilizers on corn yield on land subject to frequent overflow. Of these tests, 13 were along the Ohio river from Davies west to Ballard county and 4 were on the Cumberland river, in Trigg, Livingston, and Crittenden counties. Practically all were on land where corn has been grown almost continuously without fertilizer. The soils were found to be adequately supplied with lime, high in available phosphorus but, in most cases, low to very low in available potassium. Fertilizer was applied in furrows on both sides of the row after the corn was up. The average acre-yields on check plots and the average increases for the fertilizer treatments were as follows:

Pounds applied per acre (N-P_2O_5-K_2O)	Ohio River Bottomland	Cumberland River Bottomland
	bu	bu
0-0-0 (check plots)	60.5	56.9
Increase over check plots		
0-60-60	3.7	6.6
60-0-60	8.2	16.5
60-60-0	5.1	9.0
60-60-60	8.5	17.2
60-0-0	4.5	8.0
0-60-0	2.6	1.8

The response obtained for the combination of nitrogen and potash was practically as great as that where phosphate also was used. The results of these tests thus indicate that there is little if any need for phosphate fertilizer on the overflow bottoms of the lower Ohio and Cumberland rivers.

Economics of corn production.—Corn production for 1946 in Kentucky averaged 38 bushels per acre. Yields and production practices, however, varied greatly from farm to farm. For similar soil on different farms in the same community yields ranged from about 30 to more than 100 bushels per acre. On 109 farms studied, production expense per bushel was in general much lower on farms with high yields than on those with low or average yields.

On 44 typical farms in 5 south-central Kentucky counties, an average of 47 bushels of corn per acre was produced in 1946. On 65 other farms in these same counties selected for high corn yields, the

average was 85 bushels per acre. In the high-yield group 16 farmers obtained 100 bushels or more of corn per acre, the highest yield being 140 bushels.

The difference in corn yield per acre between the high-yield and the typical group was 38 bushels. Assuming the price of corn at $1.25 per bushel, the value of the increased yield in 1946 was $47.50 per acre. Three times as much fertilizer, 50 percent more plants per acre, use of level upland or bottomland, and use of hybrid seed were the significant differences in production practices between the two groups. Most of the land had been limed in both groups. Very little manure was used on the land in either group. In the five counties weather during the 1946 growing season was very favorable for corn production.

Spread and abundance of European corn borer.— As a result of surveys made during the fall of 1946, 71 Kentucky counties are now known to be infested with European corn borer. Counties found infested for the first time were Adair, Bath, Bourbon, Caldwell, Casey, Edmonson, Gallatin, Grant, Green, Metcalfe, Monroe, Montgomery, Nicholas, Owen, Robertson, and Taylor. Nine counties were surveyed to determine the present density of infestation. The average number of borers per 100 plants was 22.7 in Anderson county, 60.3 in Boyle, 139.4 in Bourbon, 151.9 in Fayette, 14.7 in Madison, 73.0 in Scott, 10.4 in Trimble, and 13.5 in Warren county. Damage in 1946 from corn borer in these 9 counties is estimated conservatively at $135,000. Infestation was found to be decreasing in some of the Ohio-river counties, but increasing greatly in the Inner Bluegrass and adjacent region to the south. On the Station farm at Lexington there was twice as much first-brood borer in 1946 as in 1945 but not quite as much second-brood borer as in 1945.

European corn borer parasites.— In 1946, 4,198 parasites furnished by the Federal Bureau of Entomology and Plant Quarantine were released in Kentucky. These were a tachinid fly *Lydella stabulans grisescens* R.D. and three small wasps, *Macrocentrus gifuensis* Ashm., *Inareolata punctoria Roman* and *Eulophus viridulus* Thoms. To date 3 of these parasites seem to be established. In Fayette county *Lydella* destroyed many corn borers over an area extending at least 2 or 3 miles in all directions from Lexington. In some cornfields on the Station farm this parasite alone destroyed over 40 percent of the corn borers. The same species is also well established in Boyle county, north of Danville. The 1946 counts also indicate that *Inareolata punctoria* killed 2 percent or more of the corn borers in some Experiment Station cornfields.

Relation of planting date to infestation of European corn borer.— In US 13, Ky 102, Ky 103, Tr. x 38-11, Reid Yellow Dent,

and Ky 72B corn, planted on 4 different dates, the corn planted before May 10 was heavily infested with first-brood borer but often (especially the early maturing kinds) escaped second-brood borer. Corn planted May 15 to May 25, on the other hand, was not much infested by first-brood borer but was often severely damaged by second-brood borer. Corn planted after June 1 had some second-brood borer but no first-brood borer.

Host plants of European corn borer.—Besides field corn this borer has been found in Kentucky infesting sweet corn, sorghum, oats, potatoes, and gladioli. Counts showed sweet corn to be more susceptible to corn borer than field corn. The life cycle of borers in sweet corn was shorter, and therefore a larger percentage of the larvae pupated to produce a second brood, and pupation occurred earlier than in field corn. The life cycle of corn borers infesting potatoes was even shorter. This means that in areas where sweet corn and potatoes are grown extensively there can be a large migration of early-appearing corn borer moths into adjacent field corn.

Labor requirements in producing corn on contour.—Farmers on rolling to hilly land in Union County, Type-of-Farming Area VII, estimated an average of about 5 percent increase in labor requirements for corn production when the crop was grown on the contour, and about 5.5 bushels higher yield per acre as a result of the contour cropping. After terracing, the corn yield increased, according to their estimates, 6.8 bushels per acre while labor requirements increased 2.4 man-hours per acre. They estimated, however, that despite the greater number of man-hours required per acre in contour farming, no greater amount of fuel was used by tractors in farming on the contour, either with or without terraces, than in non-contour farming.

Yields of hybrid and open-pollinated corn.—Twelve white hybrids and 10 yellow hybrids were grown in comparison with Boone County White and Reid Yellow Dent, open-pollinated varieties, in yield tests in Fayette, Todd, Caldwell, Breathitt, Madison, Trigg, and Fulton counties. The average yield of the 24 varieties for all locations was 86.1 bushels per acre, although only 15 of the varieties were tested in all 7 locations. The season was very favorable and yields in all locations were high, average yields being:

	Bushels per acre
Fayette county	88.7
Todd county	71.2
Caldwell county	86.1
Breathitt county	90.3
Madison county	101.1
Trigg county	90.3
Fulton county	66.7

The white hybrids averaged 88.3 bushels per acre (average of all tests), 10.1 bushels, or 12.9 percent, more than Boone County White. The yellow hybrids averaged 85.3 bushels per acre, 9.6 bushels, or 12.7 percent more than Reid Yellow Dent. The two white hybrids grown commercially in Kentucky out-yielded Boone County White 9.3 percent; they ranked 4th (Ky 203) and 18th (Ky 72B) while Boone County White ranked 20th. The three yellow hybrids grown commercially outyielded Reid Yellow Dent 9.8 percent, ranking 13th (Ky 102), 16th (Ky 103), and 21st (US 13), while Reid Yellow Dent ranked 24th.

The experimental white hybrids, Ky 210, Ky 223, and Ky 405B, which ranked high in 1945, again were high. Ky 405B yielded slightly less than Ky 203 but stood up much better. This hybrid will be in large-scale commercial tests with farmers in 1947. Ky 408 and Ky 410 tested for the first time in the statewide tests, showed much promise. Indiana hybrids 901A and 750A appear to be adapted to Kentucky. Ky 137 and Ky 158 yellow hybrids were again high yielding and had good standability. Ky 158 will be in large-scale commercial tests in 1947. Dixie 44 and Ky 174, tested for the first time in state-wide tests, outyielded the three commercial hybrids grown.

The hybrids varied somewhat in rank in the individual locations, depending on seasonal conditions. However, the high-yielding hybrids were generally high-yielding in all the locations.

Yields of commercial corn hybrids.—Thirty-six commercial hybrids sold and grown in the Pennyroyal district were tested in Todd county in cooperation with the Pennyrile Grain Improvement Association. Drouth through most of the growing season reduced yields somewhat and also contributed to variability in yields. There was no significant difference in yield in the top 15 hybrids. The white hybrids in this test averaged 65.1 bushels per acre and the yellow hybrids 63.8 bushels. In general, higher yields were obtained with the later-maturing hybrids even with the shortage of moisture. Exceptions were Funk's G125, US 13, and Pioneer 300, which were high-yielding although early maturing. The prolific hybrids, Funk's G125 and Tenn. 10, were high yielding but produced small and poor-quality ears. In a season with abundant moisture the prolific hybrids would be expected to be high yielding. Importance of using reliable seed was shown by variations in yield of the same hybrid from different seed sources.

Relative yields of 5 commercial corn hybrids at different levels of fertility.— Relative yields of 5 Kentucky-grown certified hybrids on plots having different levels of soil fertility at the Greenville Experiment Field were practically the same in 1946 as in 1945. The 5 hybrids were grown in single rows repeated six times on each of the

several fertility plots. The average yields for the two years were as follows: Ky 203, 60 bushels per acre; Ky 102, 58.9; Ky 72-B, 57.3; Ky 103, 53.0 and US 13, 50.8 bushels per acre. This was also the ranking on plots at each different fertility level. The average yield of all the hybrids in 1945 on the untreated plot was 12.3 bushels and on the plot receiving manure, limestone, and superphosphate, 67.7 bushels per acre. In 1946 the corresponding averages were 8.1 and 86.8 bushels per acre.

Tests of corn inbred lines.—Nine white and 17 yellow inbred lines comprising the most promising lines from Kentucky and other experiment stations were tested at Lexington in all possible single-cross combinations, to determine the lines best suited for hybrid combination. In addition, 30 established yellow lines and 28 established white lines were tested as top-crosses. On the basis of these tests, only a few have been retained as being suitable for hybrid combination in Kentucky.

Forty-five first-generation yellow lines and 48 first-generation white line, top-crossed in 1945, were tested in comparison with standard top-crossed inbred lines. On the basis of these tests over half of each were considered too low-yielding to warrant further selfing. The remainder will be self-pollinated further and the lines with the best root and stalk qualities and disease and insect resistance will be selected.

Out of 77 white and 71 yellow first generation pollinations selected out of open-pollinated varieties in 1945 and top-crossed in 1946, over 60 percent of each were discarded on the basis of their behavior in the top-cross field. The remainder will be tested for yield before continued selfing.

Hybrid popcorn.—Nine Purdue hybrids, in commercial use in Indiana, were tested at Lexington in comparison with South American and Supergold open-pollinated varieties. Yields were low (average 2,422 pounds of ear corn per acre) because of poor stands and complete lodging following a heavy rain and wind in mid-August, which prevented normal filling of the ears. The nine hybrids averaged 2,497 pounds per acre, 20 percent more than the two open-pollinated varieties, which averaged 2,080 pounds. Purdue 34, tested for the first time, was the highest yielding, outyielding the open-pollinated varieties 40 percent. Purdue 38 ranked second as in the 1945 tests. Purdue 32, which was high in previous tests, ranked 5th although the differences between it and the highest yielding hybrid were not significant. Purdue 32 has the best popping qualities.

"Scattergrain" white corn hybrids.—In the fall of 1945 a number of farmers' fields of hybrid corn were reported in Kentucky, Tennessee, and Indiana to have failed to set seed properly. In several

fields examined near Henderson the seed set ranged from about 20 percent to about 85 percent. The hybrids concerned were locally designated as "scattergrain" hybrids. Evidence pointed to male sterility on a field-wide scale as the cause of the poor seed set. The amount of sterility occurring in the same hybrid varied from field to field and seemed to be worse in bottomland fields planted late.

In cooperation with the U. S. Department of Agriculture, observational plantings of single crosses involving suspected inbred lines and several of the "scattergrain" double crosses were made at Lexington, Berea, Owensboro, and Henderson, Kentucky, and at Beltsville, Maryland, in 1946. The data obtained do not permit a critical analysis of the cause of the sterility but the trouble occurred only when 33-16, an old inbred line developed in Indiana, was used as the seed parent in making the singles and only when it occurred in the seed parent in making the double cross. Sterility was also influenced by contributions from the male parent. Expression of the sterility is much influenced by environment.

Hardiness and yield of winter oats.— Of 30 varieties and selections grown at Lexington and Lebanon in winter survival tests several were killed nearly 100 percent and only three varieties (Wintok, Fulwin, and Hairy Culberson) survived more than 50 percent. In a rod-row yield test of 34 varieties at Lebanon, Fulwin, Lemont, Traveler 1, and two selections of Lee-Victoria x Fulwin, yielded more than 60 bushels and survived the winter better than most other varieties.

Of 4 varieties grown in 1/40-acre plots at the Pennyrile Grain-testing Field in Todd county, where winter survival was good, Fulgrain and a Lee-Victoria x Fulwin selection were outstanding because of their strong straw. The latter was the only strain free of crown rust. Both strains yielded over 73 bushels per acre, significantly more than Fulwin.

Varieties of spring oats.— Eight varieties of spring-sown oats grown in field plots averaged 41.5 bushels per acre and 19 varieties in rod-row tests averaged 38.1 bushels. Low average yields were largely due to a relatively new disease *(Helminthosporium victoriae)* which was very severe on many varieties. With one exception, a selection of Victoria-Richland x Morota-Bond, all varieties and strains with the Victoria gene for crown rust resistance were heavily damaged by this disease. This was shown by broken straw and severe reduction in yield. Columbia, Fulton, Clinton and Benton were only lightly infected. Several new strains having the Bond rather than Victoria type of crown rust resistance also showed promise of being resistant to the new disease.

Vicland, Tama, Boone, Vikota, Cedar, Osage, Neosho, Ventura, and C. I. 4140, which have done exceptionally well in years when

Helminthosporium was not present, were severely reduced in yield and will probably not be satisfactory in Kentucky in years when this disease develops.

Varieties of winter barley.— In barley test plots this year most varieties survived 80 percent or better. In plot tests Kentucky 1, Purdue 21, Purdue 28154, and Purdue 28156 were significantly higher yielding than Reno. In rod-row tests of 16 varieties, Wong, Jackson 1, Ohio 1, Admire, Tennessee Winter, and W. Va. 1-34-127 were equal to Kentucky 1, in yield, while Missouri Early Beardless, Iredell and Reno were definitely lower yielding. In field plots at the Pennyrile field in southern Kentucky, Ky 1 significantly out-yielded Missouri Early Beardless, Purdue 21, Purdue 28154, and Wong. On the basis of all tests the past three years, Ky 1 is the best winter barley available for Kentucky.

Several new selections from a composite cross continue to show high resistance to mildew, net blotch, and scab, and are now being increased for further test.

Varieties of winter wheat.— Of 11 varieties grown in plot tests, Thorne, Vigo (a new variety released by the Indiana station), Nured, and Ky NS 6 (Posey's Bluestem) were the highest yielding. In rod-row tests of 18 varieties, Clarkan, Wabash, Purkof, and another new Indiana strain also were high yielding.

At the Pennyrile field in Southern Kentucky, a severe spring infestation of Hessian fly reduced all yields, the average of all 13 varieties being only 11.6 bushels. The least infested varieties were Clarkan and Fulcaster. These two varieties and Hardired (Cokers No. 5) were the highest yielding. Hardired, however, is very winter tender and can be expected to be damaged in severe winters. While heavy damage from fall infestation of Hessian fly can be minimized by observing the fly-free planting date, the only method of control of spring damage is by use of resistant varieties. New strains are being tested at the Pennyrile field for their reaction to this pest, as well as to major wheat diseases.

Fescue seed production.—Acre-yields of seed in 1946 from field plots of Ky 31 fescue sown in 1944 were as follows:

How sown	*Rate of Seeding per Acre pounds*	*Acre-Yield of Seed pounds*
Broadcast	20	138
Broadcast	8	166
Rows 30 inches apart	2½	233
Rows 15 inches apart	5	260

At Greenville, two plots of ¾ acre each were sown with Ky 31 fescue in September 1944, one plot at the rate of 20 pounds of seed per

acre broadcast, and the other at the rate of 5 pounds per acre in rows 24 inches apart. Yields of seed in 1946 were 130 and 265 pounds per acre, respectively.

At Lexington and at Greenville Ky 31 fescue sod 10 and 8 years old, respectively, produced 84 pounds of seed per acre.

Grass species and varieties.— Essentially pure stands of grasses sown in October 1942 and fertilized subsequently in spring and fall with 30 pounds of nitrogen per acre, produced the following amounts of dry matter per acre in 1946 from the first and second cuttings, respectively: tall oat grass, 3,533 and 1,421 pounds; redtop 3,574 and 247 pounds; tall fescue 2,358 and 1,096 pounds; Kentucky bluegrass 1,191 and 741 pounds; Southern Smooth Bromegrass 1,752 and 455 pounds. Orchard grass 1,885 and 632 pounds; creeping red fescue 932 and 569 pounds. Timothy was nearly all dead in the fall of 1945. Meadow fescue was dead at the end of 1944. Though creeping red fescue lived satisfactorily, the species may be considered relatively unproductive on good soil in Kentucky.

Though the total yields of the varieties of tall fescue differed somewhat in 1946, the differences were not statistically significant. Only in 1944 was there a significant difference in yield between the varieties in this test, Ky 42 producing 2,734 pounds per acre and Alta, 1,914 pounds.

Yields from each of 60 different strains and varieties of Kentucky bluegrass ranged from 884 to 3,506 pounds of dry matter per acre. The highest yield was produced by a Kentucky selection and the lowest by a commercial lot. All commercial lots were distinctly poorer in herbage produced than the best ten strains developed by the Kentucky Station. Likewise all strains obtained elsewhere produced substantially less herbage than the ten superior Kentucky Station strains.

Southern strains of smooth bromegrass produced 2,207 to 3,257 pounds of dry matter per acre whereas northern strains produced 1,225 to 1,893 pounds per acre. These yields, together with those of previous years, show clearly that Southern bomegrass as a group is superior to Northern bromegrass. However, it is also evident that strains of Southern bromegrass differ greatly in productivity in Kentucky.

Orchard grass strains produced from 2,027 to 3,175 pounds of dry matter per acre. An old Kentucky strain produced 2,404 pounds per acre. Strains of creeping red fescue produced 1,500 to 2,328 pounds.

It is obvious that hay and pasture yields are greatly dependent on choice of strain and variety of legume and grass forage crops.

Effect of fertilizer applications and insects on production of seed of Kentucky bluegrass.— In the investigation of causes of the deterioration of the Kentucky bluegrass seed crop, particular emphasis was given this year to the role played by insects and soil fertility

levels. Tests were laid out in the autumn of 1945 on 10 farms in Fayette, Bourbon, Jessamine, and Clark counties. Fertilizer applications were made in the autumn and spring to determine the influence of nitrogen, phosphorus, and potassium upon the quantity and quality of the seed produced. A mixture of trace elements including magnesium, manganese, zinc, copper, boron, and iodine also was tested. Insect population levels were determined from sweeps made in the spring of 1946 for *Amblytylus nasutus, Miris dolobratus,* and various species of leafhoppers.

Late autumn application of nitrogen had little effect upon the following seed crop, but an application of 40 pounds of elemental nitrogen per acre in late February doubled the yield of rough-cured seed per acre, tripled the yield of clean seed, increased the clean-out percentage by 40 percent and the number of panicles per acre by 40 percent. Neither autumn nor spring application of phosphorus, potassium, or the trace elements upon inner bluegrass soils had any pronounced effect on production of bluegrass seed.

The relationship of insect population levels to seed production was studied intensively on 5 of the 10 test farms. *Amblytylus nasutus* appeared to be a strong factor in determining the amount and quality of seed produced. *Miris dolobratus* and the leafhoppers were present in much smaller numbers than *Amblytylus nasutus* and had little effect on the size and quality of the seed crop.

Control of green June beetle larvae.—Lead arsenate at rates of ½, 1, and 2 pounds to 100 square feet was applied on Kentucky bluegrass sod in the spring of 1943 to determine its effectiveness in controlling larvae of green June beetle for one or more years. There were 6 replications of each treatment and 6 untreated plots. The treatments still gave very good control the fourth year, the ½-pound treatment killing 82 percent of the grubs, the 1-pound treatment 91 percent, and the 2-pound treatment 96 percent.

Control and life histories of wireworms.—The wireworm *Conoderus lividus,* one of the injurious species in Kentucky, attacks field and truck crops and is found most frequently in Kentucky bluegrass sod. The larval period is 1 or 2 years. Some larvae from eggs laid July 1 to 7, 1944, completed their development in the summer of 1945 and the rest in 1946. In 1946, larvae pupated May 22 to July 15, and adults transformed from the pupae June 9 to July 27, 1946. There were 79 complete rearings and the average cycle from egg-laying to the adult stage was 1 year and 354 days.

Larvae from eggs laid June 30 to August 13, 1945, developed in a manner similar to those from eggs laid in 1944. Some of the larvae lived over the winter of 1945-46, pupated May 24 to July 18, 1946.

and transformed to the adult stage June 7 to July 30. There were 166 rearings and the average cycle from egg-laying to the adult stage was 357 days. The rest of the larvae from eggs laid in 1945 entered the winter of 1946-47 as partly grown worms.

Plant bugs Miris Dolobratus and Amblytylus nasutus.—*Miris dolobratus* was not very numerous in 1946 in Kentucky bluegrass fields. Nymphs were found first on April 2, adults May 6, and the last adult in the field June 6. Eggs were being laid May 16. The number was largest about the middle of May when adults and nymphs were practically equal in number. The average number of bugs to a sweep of an insect net was 3.1 for 1,917 sweeps on 9 farms, including the Experiment Station farm. The largest number taken in a single sweep was 91. The numbers differed considerably on different farms. In 10 fields where grazing of bluegrass by cattle was permitted in the fall of 1945 and spring of 1946, there were fewer *M. dolobratus* than in plots where grazing was not permitted in fall or spring. There was an average of 2.3 times as many bugs on the unpastured plots as on the pastured fields and the range was 1.3 to 4.1.

On some farms *Amblytylus nasutus* was found in 1946 in numbers large enough to cause damage to seed formation in bluegrass. The average number for 1,892 sweeps of an insect net on 10 farms was 14.7 a sweep. The largest number taken in any single sweep was 227.

The first nymphs were found April 6, the first adults May 8, and the last adults in the field June 1. Egg-laying began May 19. The number was largest May 10 to May 15. Practically all nymphs had transformed to the adult stage by May 19. The averages of 15 sweeps of a net from each of 30 plots of bluegrass ranged from 10.7 to 66.5 per sweep. Grazing bluegrass reduced the number of this bug the same as of *M. dolobratus*.

White grub control.—May beetle *(Phyllophaga)* grubs were collected from 75 random 1 sq. ft. samples of sod in a 1½-acre pasture area treated in 1944 with spores of milky disease, which in eastern states had proved very effective against Japanese beetle larvae. The May beetle grubs collected were incubated and examined by the Federal Japanese Beetle Laboratory at Moorestown, New Jersey. None of the grubs carried the milky disease. The number of white grubs in the area sampled was estimated at 75,200 per acre.

Spray tests comparing 4 pounds of lead arsenate with 1 pound of actual DDT in 100 gallons of mixture, for control of May beetles, were continued early in May, using adults of *Phyllophaga hirticula* (Knoch). Mortality was less than in previous years, probably due to cool weather. After 5 days, DDT had killed 85 percent of the males and 43.3 percent of the females, while lead arsenate killed 66.7 percent of the males and 43.3 percent of the females.

Taxonomy of white grubs.— Studies on the separation of various species, genera, and subfamilies of the family Scarabaeidae, were continued and keys and descriptions prepared so that injurious may be distinguished from harmless forms. Through extensive rearing and collecting, larvae of one or more species of the genera *Pleocoma, Coenonycha, Dichelonyx, Hoplia, Macrodactylus, Pocalta, Polyphylla, Phobetus, Serica, Psammobius, Pleurophorus, Phyllophaga, Aphodius, Cyclocephala, Plusiotis,* and *Strategus* were secured.

DDT-impregnated bags for protecting stored products from insects.— DDT dissolved in carbon tetrachloride was used to impregnate cotton bags in which insect-free shelled corn was stored. Solutions containing 2½, 5, and 10 percent of DDT were prepared and the bags were impregnated (1) by dipping them in the solution, and (2) by spraying the solution onto the bags. Large and small cotton bags were used, the small bags being made of thinner cloth. Untreated bags were used for comparison. After nearly 3 months the DDT was giving adequate protection in all treated bags. The grain in all the small check bags was infested.

Carbohydrate metabolism of Johnson Grass.—The various carbohydrate fractions were followed in each of the three parts of Johnson grass (tops, rhizomes, and fine roots). Total dry weight of each part gradually increased through the growing season. During the initial growing stage reducing sugar rose in rhizomes and roots while sucrose decreased. Both decreased in the tops. At seeding a sharp reversal occurred in rhizomes and roots, and sucrose increased in the tops. About 30 days after seeding all values began to level off, showing slight fluctuations depending on weather and soil conditions. Throughout the growing season starch remained more or less constant in all parts when once established after sprouting. Water and soil drainage seem to play an important part in sugar synthesis and storage after seeding.

Improved variety of red clover.— The new variety of red clover developed cooperatively by the Kentucky Agricultural Experiment Station and the Bureau of Plant Industry, U. S. Department of Agriculture, produced 8,065 pounds of dry matter per acre from the first and second cuttings and 1,056 pounds from a third cutting. Kentucky 215, one of the best of the old adapted varieties, produced 7,684 and 422 pounds of dry matter, respectively. The better yield of the new variety from the first and second cuttings appeared to be caused principally by its superior vigor while the third cutting was larger because the stand remained very good, whereas the stand of Kentucky 215 became poorer after the second cutting. The much greater longevity of the new variety than of Kentucky 215 and other well-adapted varieties is perhaps its outstanding superior characteristic.

This new variety, formerly known tentatively as "Southern Selection," has been named "Kenland." Though it is definitely a superior variety in its present stage of development, efforts to improve it further will be continued. Meanwhile Kenland is being released as rapidly as possible for farm use.

Legume varieties and strains.—Five lots of the Cumberland variety of red clover produced 7,209 to 7,811 pounds of dry matter per acre from three cuttings; Midland, 6,750 pounds; Wisconsin Mildew Resistant, 5,865 pounds; Montgomery, 2,770 pounds; and Kenland, 9,121 pounds.

Two lots of Argentine alfalfa sown in late August 1945, produced 6,135 and 5,520 pounds of dry matter per acre from three cuttings; Buffalo, 6,617; Ranger, 6,838; Hardigan, 7,138; and Atlantic, 8,363. Many plants in the plots of Argentine alfalfa died during the winter, whereas few if any of the other plots died.

Thirteen varieties and strains of Korean lespedeza obtained from the Bureau of Plant Industry produced 1,428 to 3,635 pounds of dry matter per acre. Selection 2892-43 produced the highest yield. Climax produced 2,127 pounds. Seed yields in other series of plots were 199 to 791 pounds per acre, Climax producing 431 pounds.

Three lots of Kobe lespedeza produced 3,579 to 4,079 pounds of dry matter per acre on plots harvested for hay. Seed yields of other plots were 668 to 700 pounds per acre.

Strains of Kentucky bluegrass and orchard grass.—Thirty-two of 35 strains of Kentucky bluegrass in replicated field plots established in September 1941 by sowing seed of apparently superior selections, produced more herbage per acre in 1946 than the commercial lots taken as a group. For the 3 years 1944-46, each of 14 of these strains produced average yields of dry matter at least 1,000 pounds above the average of the commercial lots.

Seed was harvested from 5 isolated crossing blocks of orchard grass set clonally in 1945. One of the blocks yielded enough seed in 1946 to permit including the cross in a field test in late summer including older Kentucky strains. In the late fall this cross appeared definitely superior in vigor of growth to the other strains included.

A few superior strains of Kentucky bluegrass and orchard grass have been obtained from the grass improvement program, but none of them has as yet been grown long enough to determine whether they will remain genetically constant from generation to generation.

Species crosses for tobacco improvement.—By crossing tobacco with *Nicotiana glutinosa,* varieties of burley and dark tobacco have been developed that remain completely free from mosaic. Species crosses have now been made in an attempt to develop resistance to the

virus disease streak, and to wildfire and angular leaf-spot. For streak resistance burley tobacco has been crossed with *N. gosseii,* an Australian species, using the latter as the female parent. The majority of the seedlings die when small, from a breakdown of the roots. Only one plant has been grown to maturity, and a few backcross seeds have been obtained following treatment with colchicine. *N. glauca* has been crossed with burley and the hybrid made fertile by treatment with colchicine. Back crosses with burley have been produced. For wildfire resistence burley was crossed with *N. longiflora.* Most of the seeds were hollow, but about forty viable seeds were sown and treated with colchicine. Of the seedlings from these, 10 were fertile. These were backcrossed with burley. A cross has also been made between the *N. glauca-tabacum* hybrid and the *N. tabacum-longflora* hybrid. This cross has proved highly resistant to wildfire.

Tobacco frogeye.— Studies on host range of Cercospora from different species of plants were continued. Typical frogeye spots developed on *Nicotiana rustica* when inoculated with Cercosporas from tobacco, petunia, henbit, lupine, *Viola* sp., pumpkin, cucumber, *Plantago, lanceolata,* pokeweed, beet, rose, *Malva rotundifolia,* coreopsis, cress, campanula, phlox, bean, and morning-glory. On garden beet, petunia, and cabbage, Cercosporas from other genera of plants caused typical infections.

Inoculation of tobacco with streak virus.— In order to test varieties of tobacco and species of *Nicotiana* for streak-resistant breeding stock, it is necessary to know how to maintain a good source of the streak virus and to have a reliable, rapid, and simple way of making inoculations. At times there is considerable variability in the virus concentration of plants used as inoculum, even in suckers of the same plant, especially in winter in the greenhouse. The effect of several factors on infection has been tested.

Leaves slightly below the primary growing point of systemically infected plants of *Nicotiana rustica* were a more reliable source of tobacco streak virus than tobacco or sweet clover tissue. Local lesions developed on every one of several hundred tobacco leaves dusted with 600-mesh carborundum and rubbed with a glass spatula dipped in *N. rustica* tissue crushed with M/10 Na_2HPO_4. Without the M/10 Na_2HPO_4 and carborundum the number of local lesions was greatly reduced. Dilution of the inoculum with M/10 Na_2HPO_4 beyond 1:2 decreased the number of local lesions, but the inoculum was still effective at a dilution of 1:32 if the virus concentration in the original inoculum was high. Additional rubbing up to a certain point increased the number of local lesions. Leaves supported on a flat surface during rubbing did not develop more lesions than leaves merely held at the tip. Very young and old leaves were not so susceptible as vigorous

medium-young leaves (fifth or sixth below growing point), especially on relatively small plants.

Reaction of 35 species of Nicotiana to tobacco streak virus.— None of the 200 accessions of tobacco tested seemed sufficiently resistant to the tobacco streak virus to be useful as breeding stock. Thirty-five of the approximately 60 described species of *Nicotiana* have been inoculated. The reaction ranged from a high degree of resistance to extreme susceptibility. Most of the species were moderately susceptible, similar to *N. tabacum*. In *N. benthamiana, N. clevelandii, N. megalosiphon,* and *N. miersii,* systemic infection caused severe necrosis, often resulting in death. *N. glauca* and *N. gosseii* seemed sufficiently resistant to have value as breeding material.

Black root rot of tobacco.— For the second consecutive year the root-rot-resistant burley varieties Ky 16 and Ky 41A showed some delay in maturing but no decrease in yield as compared with Ky 22 and other recently developed varieties of a much higher degree of resistance, when grown in black-root-rot soil. Under the same conditions several varieties locally grown were nearly complete failures. The cool, wet setting season favored development of black root rot.

New burley tobacco varieties.— Ky 22, grown rather extensively by farmers in 1946, is highly resistant to black root rot, is of the standing-up type, and is of higher quality than Ky 16 but yields less and tends to produce more suckers. Ky 56, tested in 1945 by a few farmers, is almost identical in appearance with Ky 16, is decidedly more resistant to black root rot, and is mosaic resistant (NN). It is recommended for extensive trial. Ky 24 is a black-root-rot-resistant burley with the plant characters of Warner. The yield is moderate and the quality high. Like Warner, it produces many suckers. Ky 25 is a black-root-rot-resistant burley with the plant characters of Golden Burley.

Mosaic-resistant One-sucker tobacco.— Ky 160 was grown in Simpson and neighboring counties in 1946 with marked success, reports indicating that it is preferred to the old One-Sucker varieties. Its use completely avoids loss from mosaic. Certified seed will be available to growers for the 1947 crop.

Mosaic-resistant dark fire-cured tobacco.— Ky 151 was grown extensively in Todd county with complete success with respect to freedom from mosaic, yield, and quality. At the Western Kentucky Substation the yield and quality were satisfactory, as compared with popular varieties.

Cause of brown root rot of tobacco.— A study was made in 1946 of tobacco roots in a series of plots where brown root rot occurs

regularly in tobacco, and in other plots where tobacco grows off rapidly following transplanting. The tobacco roots in the brown-root-rot plots were found to be heavily invaded by what appeared to be the meadow nematode, *Pratylenchus pratensis*, while in plots where tobacco grows off rapidly this nematode was rare or was not found. Grasses and legumes known to aggravate brown root rot were found to be heavily invaded by apparently the same nematode. Roots of certain weeds were heavily invaded by the nematode, while ragweed, known to be an excellent plant to precede tobacco as far as brown root rot is concerned, has so far been found to be free. An old bluegrass sod where tobacco in small plots starts rapidly following transplanting was free except in a few small areas.

Tobacco varieties have shown the same degree of resistance or susceptibility to brown root rot in Ontario, Canada, and at Lexington, suggesting that the cause of the disease is the same in both areas.

Mosaic in primed tobacco.—Considerable damage from mosaic was found in burley tobacco in 1946. This increase over normal, or over what a casual inspection would disclose, was quite noticeable during the priming tests on farm fields. The primer had an excellent opportunity to note this damage as the leaves were picked from the stalks. Much of the mosaic found was of the burning type. The disease was most prominent from the lug section of the plants to the top leaves, indicating late infection. Diseased leaves that were primed and cured produced tobacco of inferior quality.

Placement of fertilizer for burley tobacco.—Four methods of placing fertilizer for burley tobacco were tested (in duplicate) on Hagerstown silt loam at the Lexington farm in 1945, a repetition of a similar experiment on adjacent land in 1944. Every third plot was a check plot on which a standard method of fertilizer placement was used. In 1945, complete fertilizer was used on the different plots in amounts to supply 60 pounds each of nitrogen, phosphoric acid, and potash per acre. In 1944 the rate was 60-50-50. On the check plots all the fertilizer was applied, near transplanting time, in a continuous band on each side of the row, about 3 or 4 inches from the plants and about 3 inches deep. On plots where the fertilizer was broadcast or applied in the plow furrow, a 10-10-10 starter application was reserved from the total and used at the row in side bands.

The average results for the two years' tests were as follows. Where no fertilizer was used the yield of leaf was 1,240 pounds per acre, valued at $33 per 100 pounds. The average on the check plots, where all the fertilizer was used at the row, was 380 pounds more than on the unfertilized plots. Where 5/6 of the fertilizer was applied broadcast and plowed under and 1/6 used at the row in side bands, the in-

crease was 410 pounds. Where 5/6 of the fertilizer was applied broadcast and disked in on the plowed ground, and 1/6 used at the row, the increase was 347 pounds. Where 5/6 of the fertilizer was applied as bands on the bottom of each plow furrow when the land was broken, and 1/6 at the row, the increase was 266 pounds. The increased value of the tobacco from the different placements over that not fertilized was from $2 to $7 per 100 pounds, being greatest where all the fertilizer was used at the row and least where 5/6 was placed in bands in the plow furrow.

Plots were included also where only two of the fertilizer nutrients were applied to determine how much of the crop response was due to each of the nutrients. The main response was to nitrogen and potassium. On soils containing about 2,000 pounds of phosphorus in the acre-plow-layer there was very little response to the addition of phosphorus.

Priming burley tobacco.— Results of priming experiments on 3 Fayette county farms bore out the results reported a year ago. On each farm plots primed 10 to 18 days before normal cutting time (the time when the farmer cut the rest of the field) and than cut 11 to 20 days later than the normal time, returned higher total yields and higher total value per acre than the unprimed plots cut at the normal time. Plots primed twice (10-18 days before normal cutting time and at normal cutting time) and then cut 11 to 20 days after normal cutting time gave higher returns than those primed only once. Averages for the 3 farms were as follows:

	Acre-yield (pounds)	*Acre-value*	*Price per 100 lb*
Not primed; cut at normal time	1,703	$ 847	$49.76
Primed 10-18 days before normal cutting time and cut 11-20 days after normal	1,897	943	49.73
Primed 10-18 days before normal cutting time and again at normal cutting time, and then cut 11-20 days after normal cutting time	2,039	1,019	49.99

Where the tobacco was primed once the returns for priming averaged $1.29 per hour of net extra labor caused by priming; and where primed twice the returns to priming were $1.37 per hour of net extra time. (These data are on the 1945 crop, full information on which could not be obtained until early in 1946.)

When to cut burley tobacco.— In connection with priming experiments, data were obtained on the relative advantages of early or late cutting of burley. Data were taken from plots on 3 farms in Fayette county. Normal cutting time in each instance was taken as the time when the farmer cut the rest of the field. For both the 1944 crop

and the 1945 crop, on each farm, total returns were highest where the tobacco was cut 11 to 20 days later than normal. Averages from the 3 farms were as follows:

	Acre-yield (Pounds)	*Acre-value*	*Price per 100 lb*
Cut 10-18 days before normal	1,485	$681	$45.84
Cut at normal time	1,703	847	49.76
Cut 11-20 days later than normal	1,784	905	50.72

Time required to cut, house, and strip the tobacco from these plots was about the same per plot, averaging 174, 181, and 175 man-hours, respectively, for the plots cut at the different times.

None of these plots was primed. The returns from the unprimed tobacco cut late, while higher than from the unprimed tobacco cut at the normal time, were $38 per acre less than from comparable plots primed once, and $114 per acre less than from comparable plots primed twice (see "Priming burley tobacco").

Work methods in bulking tobacco.—Further study of work methods in bulking tobacco led to the development of a tobacco stick holder, by use of which one man can do the job which otherwise usually requires two men working as a crew. And by using the stick holder in connection with the self-releasing lowering hook developed at this Station, tobacco can be taken down and bulked by one man. Two men take a total of 4½ man-hours per acre to pull tobacco from the stick and place it in bulk. Use of the stick holder saves 10 percent of the time and makes bulking easier. The use of self-releasing hooks in lowering tobacco from the rail and the stick-holder in bulking is of major importance to Kentucky burley tobacco growers, over 75 percent of whom have less than 2 acres of burley tobacco per farmer.

Price differences among tobacco grades.—Not over 2 percent of burley tobacco was used in the manufacture of cigarettes three or four decades ago, but probably 60 percent is used in cigarettes today, and the type of burley produced has changed from heavy-bodied red tobacco to lighter-colored and lighter-bodied tobacco. Along with these changes in production and consumption have come decided changes in price relationships between grades.

Government reports for grades of burley tobacco are available only in recent years but even in that period they show decided changes in the intergrade price relationships. Among the five qualities within some color groups, the range in price from highest to lowest grade has remained fairly constant but the difference between the better qualities has decreased and the difference between lower qualities has increased. This tendency has prevailed particularly in the Flyings group.

In Lugs the spreads have decreased while in most colors of Leaf and Tips the spreads have increased.

The difference in price between 2nd and 3rd quality Tan Flyings, for instance, during 1933-35 was $3.65 per 100 pounds, and during 1942-44 only $1.00. The difference between 4th and 5th quality rose from $5.60 to $9.00, but the difference between 1st quality and 5th quality was $15.95 during the first period and $16.00 during the second 3-year period. A similar situation prevailed in Buff Flyings.

In Tan Lugs the spread in price between 2nd and 3rd quality dropped from $3.55 per 100 pounds to $1.00 in the 9 years. Between 4th and 5th quality the spread also declined from $7.45 to $6.00 with the total spread from 1st quality Tan Lugs to 5th quality decreasing from $17.70 to $9.00.

In the Leaf and Tip groups the spreads in price between grades have tended to increase, for the most part. For example, in Red Leaf the spread between 2nd and 3rd quality rose from $3.10 per 100 pounds to $6.00 while that between 4th and 5th quality rose from $2.80 to $6.85. The spread from 1st quality to 5th quality rose from $12.25 to $21.70.

The general result of these changes in price relationships is that the prices of light-bodied grades, which are of use for cigarettes, have moved closer together, while prices of the grades used more generally in chewing tobacco have held or increased their differences.

Tobacco stalks, hemp hurds, and sorghum bagasse as sources of industrial cellulose.— The method of cellulose determination as worked out in this laboratory was found to have certain advantages over the Norman-Jenkins standard method of cellulose determination as to (1) shorter time, (2) easier manipulation, (3) higher alpha-cellulose yield, (4) lower chlorine concentration in bleaching, and (5) lower ash content of cellulose.

A laboratory batch pulping method was worked out, and the pulps produced were made into cardboard and heavy bond papers. The bond papers were of nearly the same weight and thickness as better-grade commercial typewriter bond papers but had a tensile strength two to three times that of the commercial typewriter bond papers. Tensile strength of the bond-type papers was found to be a direct function of the beating given the pulps, done in this case with a Waring blender or a laboratory beater designed and built especially for this work.

Nicotinic acid by oxidation of nicotine.— A yield of 55 percent theoretical was obtained by the oxidation of nicotine by $KMnO_4$ in sulfuric acid solution with a selenium catalyst. The product was pure, with melting point of 235-7° C. It was isolated from the reaction

mixture as copper nicotinate, which was subsequently hydrolyzed with H_2S and the free nicotinic acid crystallized.

Properties of tobacco wax.— A dark brown wax isolated from low-grade cured tobacco leaf at the rate of about ½ pound of wax per 100 pounds of leaf exhibited little change in color but lost its odor of nicotine when treated with H_2O_2 and acidified Na_2SO_3. The purified wax melts at 71 - 73° C., is extremely water insoluble, and in most water-organic solvent systems it forms a persistent emulsion which breaks only with difficulty.

Split application of nitrogen fertilizer on potatoes.— By means of tissue tests made on potato plants from the period of early vine growth to maturity, it was found that potatoes need the largest amounts of nitrogen and potash in the late stages just after blooms appear and tubers start to enlarge. By making applications of half of the nitrogen at planting time and the other half at bloom time the yield was increased 83 bushels per acre over the same amount of nitrogen all applied at planting time. No late potash applications were made but those plots which tissue tests showed were high in potash in the late stages yielded 56 bushels more per acre than the low potash plots. There was strong evidence that large amounts of potash at tuber enlarging time enabled the potatoes to utilize large amounts of nitrogen in sizing the tubers and storing the large amounts of starch necessary for a large yield.

Tomato varieties.— The 1946 season was quite unfavorable for tomatoes. Of 31 varieties tested, the following varieties ranked best on the basis of size and yield: U.S. 18, Master Marglobe, Campbell 409, Pritchard, Grothen's Globe, Garden State, Campbell 164, Rutgers, and Stokesdale.

Tomato fruit-worm control.— In greenhouse tests using green fruits artificially infested with small fruit-worms, the new British insecticide Hexachlorocyclohexane used as a 5-percent dust gave very poor control (17.6 percent mortality) compared with 100 percent mortality from a dust containing 3-percent DDT and 5-percent mortality in the untreated check fruits. In field tests no fruit-worm infestation developed.

Hybrid sweet corn.— Three varieties that had shown merit in previous years were, in order of yield in 1946, Tristate, Golden Grain, and Aristogold Bantam Evergreen. On basis of size of ear they ranked Golden Grain, Tristate, and Aristogold Bantam Evergreen. All these varieties have a light yellow kernel and their quality is excellent.

Varieties of lima beans.— Fordhook 242 produced 6.51 tons of unshelled beans per acre; Early Market, 4.37 tons; Fordhook, 4.35

tons; Asgrow Fordhook, 4.05 tons; and Burpee's Improved Bush, 3.52 tons. Burpee's Improved Bush produced the largest beans, medium green, and flat. Early Market produced beans medium in size, pale green, and flat. Beans of Fordhook were green and plump; those of Asgrow Fordhook were similar but smaller. Fordhook 242 produced small beans, medium green, and plump.

Effect of nitrogen fertilizer on lima beans.— Use of ammonium nitrate was varied to regulate the amount of nitrogen available to the plants during the early vine growing period and during the fruiting period after bloom. Applications during vine growing tended to depress yields, but during the fruiting period after bloom applications of nitrogen were associated with highly significant increases in yield.

Orchard spray service.— This project continued to grow in popularity and demand among commercial fruit growers. There was an ever-increasing demand to visit fruit farms and consult with the owners on their problems. The program was operated along the same lines as in the past. During the spray season cooperators over the state sent in daily reports by mail or telephone on insect, disease, and fruit development. These reports were checked with local happenings, personal field inspections, and reports from surrounding states, and the accumulated information was put into spray letters (total of 12,963 spray letters during four months) which went to growers in 110 counties and to all county agents. In addition, weekly reports on insect, disease, and fruit development from the regional spray service office (a cooperative project of Illinois, Indiana, and Kentucky) was broadcast each week over a number of midwest radio stations.

Apple scab.— Apple leaf samples were sent in regularly during the scab season from cooperators at Fulton, Paducah, Henderson, Bowling Green, Louisville, Ludlow, and Cold Spring. Overwintering scab spores were mature at Princeton on February 26 (first examination) and at Cold Spring by March 17. Early maturity of spores and a cool, wet April and May were favorable for scab development; nevertheless control was unusually successful and general.

Peach pruning.— Elberta peach trees near Henderson, in their 8th growing season under different systems of pruning, yielded as follows this year:

Type of Pruning	*Number of Trees*	*Bushels per Tree, Average*	*Number of Peaches per Bushel, Average*
No pruning	2	5.24	155
Modified leader	8	6.95	177
Open center	9	7.02	181
Converted, modified to open	6	7.56	213

This was the first year since the trees came into bearing that the unpruned trees failed to bear more than the others. Fruit on the unpruned trees this year was borne only in the top and the outside shell of the trees, because the fruiting wood in the interior and lower parts of the trees had been shaded out and killed by the dense growth above. This experiment so far would indicate that little or no pruning should be done in a young peach orchard, but after 7 or 8 years, depending on the size and vigor of the trees, more pruning will be profitable.

Peach insect survey.—During Elberta harvest a survey of insect injury to fruit was made in a number of western Kentucky peach orchards. Plum curculio was unusually abundant this year, with as high as 63.1 percent of the crop injured in one orchard. In general, injury from oriental fruit moth was less in 1946 than in previous years but at the Station orchard at Princeton 50.6 percent of the fruit was infested. Cat-facing caused by plant bugs, curculio, and other insects was fairrly common, being found on 7 to 27.5 percent of the peaches examined. In one orchard over half the fruit had scale spots, showing the need for better control of San José scale.

Oriental fruit moth parasites.—A total of 1,322 peach twigs infested by the oriental fruit moth was collected from 7 western Kentucky peach orchards and sent to the Federal Oriental Moth Laboratory at Moorestown, New Jersey. *Macrocentrus ancylivorus* Rohwer, important introduced parasite, was recovered from 5 of the 7 orchards. No parasites of any kind were recovered from an orchard where DDT was used to control oriental fruit moth in 1945 and 1946. Total parasitism in one orchard where *Macrocentrus ancylivorus* Rohwer was introduced in 1943 reached 71 percent in the 1946 twig collection.

Promising new varieties of apples.—The following varieties, of recent introduction, have shown exceptional merit in trials at the Kentucky Agricultural Experiment Station:

HARRALSON: During the past 7 years this variety has borne at an early age and produced heavy crops, ripening at Lexington from August 24 to September 10. The fruits are large, red-striped, uniform in shape, and of excellent cooking quality. It is recommended for trial for home use and local markets.

ANOKA: Its outstanding merits are fruitfulness at an early age and high cooking quality. The fruit is small and ripens in mid-July.

CLOSE: Chief merit is its very early ripening—slightly earlier than Transparent. The fruit develops a dull red color and has excellent cooking quality. The trees have been only moderately productive.

RED BIRD: Extra early ripening, 2 or 3 days ahead of Transparent. Red striped, with subacid flavor and good cooking quality. Although

reported by others as a shy bearer, it has produced good crops at the Experiment Station. It is believed that the early blooming Henry Clay variety standing near by provided effective pollination, and that poor pollination may be the cause of low production in some orchards.

LODI: This variety of the Transparent type has continued its record of good crops of large, handsome apples that ripen slightly later than Transparent. It is recommended for trial as an early variety for commercial planting.

RED GRAVENSTEIN: Ripens from July 15 to 25. Similar to the old and well-known Gravenstein, except that the fruit is a handsome dark red. One of the best cooking apples; prized for home planting. Chief fault is tardiness in coming into bearing.

ORLEANS: Of the Delicious type, except that the flavor is subacid and the fruit has good cooking quality. Ripens early in September.

MACOUN: A high-quality variety of the McIntosh type, ripening August 25 to September 5. Fruit of medium size and a handsome dark red. One of the best dessert and cooking apples of its season.

KENDALL: Another handsome bright red apple of the McIntosh type. Fruit large, excellent for dessert and cooking. Ripens about a week earlier than Macoun.

Dwarf apple trees.— Dwarf apple trees 3 and 4 years old, grown in bluegrass sod with a cultivated area 4 feet in diameter around each tree, bore fruit in 1946. On some trees the load of fruit was so heavy that it was necessary to tie the trees to a strong stake to hold them upright. Apparently the root system was weak, and this might be a fault that would result in a short life. The fruits were large, averaged about 8 ounces each. For the several varieties, the number of fruits per tree averaged from 8 to 72.

Codling moth control.— In the Experiment Station apple orchards in 1946, DDT gave excellent control of codling moth even where injury had been severe in former years. Six first-brood cover sprays were used, containing 2 to 4 pounds of lead arsenate and 6 ounces of actual DDT per 100 gallons of mixture, followed by 3 summer sprays of 6 ounces actual DDT and 2 pounds of commercial 14-percent nicotine-bentonite. Fungicides were added as needed. At harvest late varieties of apple such as Grimes, Red Delicious, Winesap, Stayman, and York were 82.9 to 93 percent clean in the old orchard at Lexington and 95 to 99.5 percent clean in the young orchard. European red mites and the common red spider became abundant in August, causing considerable foliage injury, especially on Red Delicious. For mite control an extra spray of 1 pound actual DDT and 1¼ pounds of DN-111, a dinitro compound, per 100 gallons of mixture, was found superior to 1 pound actual DDT and 1 quart of summer oil.

Plum varieties.— The Stanley plum, of the prune type, is the best of a number of varieties tested recently. The fruit is large, dark blue, and of excellent quality, and the tree is very productive.

Grape varieties.— Portland, a variety introduced a few years ago by the New York Experiment Station, has shown much promise in Kentucky as one of the best early white varieties. Vines planted in 1945 made excellent growth and bore an average of 3.85 pounds of grapes per vine in 1946. Trials at the Kentucky Station with the recently introduced Concord Seedless grape have been disappointing. To date, the yield has been low, the clusters and fruits very small, and the quality only fair.

Black raspberry yield.— A planting of Morrison black raspberries, in its second season, produced at the rate of 254 crates (24 pints each) per acre, and Quillen, also in its second season, produced at the rate of 234 crates per acre.

Strawberry varieties.— Tennessee Beauty was superior in yield, size, and attractiveness to all other varieties tested at the Experiment Station this year. This new berry has made a good record in tests by leading strawberry growers and is recommended for trial in all commercial strawberry areas.

Red stele disease of strawberries.— In 1946 red stele disease caused much damage to the strawberry planting on the Experiment Station farm and seemed also to be spreading in commercial areas. Blakemore, Premier, Catskill, Fairfax, Tennessee Shipper, Tennessee Beauty, Tennessee Supreme, and Gandy were susceptible—all to about the same degree.

Strawberry mulch.— Following the mild winter of 1945-46 strawberries mulched in March yielded as well as those mulched in December. In 6 of the past 8 years, however, the December-mulched plots have yielded significantly more than the March-mulched plots. Again this year (for the fourth straight year) a mulch of 1½ tons per acre in December was better than a mulch of 2 tons per acre in December.

Effect of strawberry mulch on soil nitrogen.— Use of a straw mulch on strawberries reduced the available soil nitrogen by 15 to 20 percent. On the high-nitrogen soil at the Experiment Station this reduction in nitrogen did not reduce yield. Red stele disease was more severe, however, in areas where soil nitrogen was low than in areas where it was higher.

Seed inspection.— During the year 6,895 samples of seed were tested, of which 653 were official samples taken by inspectors in the field. The remaining samples, sent to the laboratory by seedsmen,

farmers, and others, included 1,565 samples of grass seed, 2,299 of legume seed, 1,343 of cereals, 773 of tobacco seed, 168 of vegetable seed, 71 of hemp seed, and 23 samples of miscellaneous seeds. Tobacco seed cleaned during the year amounted to 3,386 pounds, less than half the amount cleaned in 1945.

Nursery inspection.— During the year the nursery inspector made 87 regular inspections, including 58 inspections of general nursery stock, 8 of fruit trees, 7 of strawberry plants, 8 of perennials, 3 of sweetpotato beds, and 3 of greenhouses. On the premises inspected the following insects and plant diseases, listed in order of frequency of occurrence, were found. *Insects:* Bagworm, Oriental fruit moth, euonymus scale, woolly aphis, white pine aphis, holly leaf miner, iris borer. Red spider ranked first among pests found. *Diseases:* Apple scab, gladiolus scab, birch leaf-spot, juniper twig-blight, cherry leaf-spot, cedar rust, peony blight, iris rot, iris leaf-spot, delphinium crown-rot, phloem necrosis.

Analyses of limestone, marl, soil, and miscellaneous materials.— During the year 142 samples of limestones from 50 counties were tested for neutralizing value and fineness of grinding. Analyses also were made of 56 samples of marls from 31 counties, 2 samples of slag, 14 samples of soil, 20 samples of water, and about 60 samples of miscellaneous materials including tobacco by-products, refuse from cleaning tobacco seed, tobacco stems, tobacco stalks, tobacco leaves, iron ores, conglomerate sandstone, boiler scale, peat moss, pyrites, and clays.

Creamery license section.— Licenses to buy milk or cream were issued to 6 creameries, 15 cheese plants, 8 condenseries, 75 milk plants and ice cream manufacturers, 25 independent operators of cream stations, and 799 cream stations under contract to creameries. Of the total of 928, 28 began operating after July 1. Authority to test for the period ending June 30, 1947, was issued to 1,054 operators using the Babcock test. These included 880 renewal licenses, 97 licenses issued since July 1 after satisfactory examination, and 77 permits pending examination issued since July 1.

Examinations for applicants for license to test were held as follows: Bowling Green 4, Lexington 4, Louisville 4, Mayfield 3, Maysville 2, Owensboro 3, Princeton 2, Somerset 2, Columbia 2, Ashland 1, special 6. Of 412 applicants notified to appear for examination 237 appeared, 217 passed, and 20 failed. Of those failed 4 reappeared and passed on the second examination.

During the year 864 inspections were made with an average of 22 tests per inspection. Operators of the Babcock test were graded as

follows: A and B (satisfactory) 462; C (unsatisfactory) 247; D (probation) 146; and E (cited to appear before the Examining Board) 9.

Of 34,283 milk and cream test bottles, cream test weights, and milk pipettes received for calibration, 150 were rejected. Items of buying equipment in use found on inspection to be incorrect or defective and a possible cause of inaccurate weights or tests were: 6 test scales, 47 cream test weights, 5 receiving scales, 1 platform scale weight, 9 centrifuges, 5 pair dividers, 7 thermometers, 447 pieces illegal glassware, and 10 miscellaneous pieces of equipment. These were condemned and ordered to be replaced.

The Examining Board decided 16 cases as follows: 3 revoked licenses were reinstated, 2 requests for reinstatement are pending, 3 were continued on probation with a decision to be based on future inspections, and 6 licenses and 2 permits were revoked because of unsatisfactory testing and violation of regulations.

Receipts for the year were $7,023.15 and expenditures $11,800.54 as itemized:

Salaries and labor	$ 8,900.55
Communication service	320.83
Freight and express	15.31
Sundry and laboratory supplies	525.68
Travel	1,957.68
Miscellaneous	80.49
Total	$11,800.54

Fertilizer control.— During the year, 890 inspection samples and 43 samples from farmers and others were analyzed and reported. Collaboration was continued with about 75 participating chemists in analysis of a monthly check sample of fertilizer. Investigation was continued on determination of phosphorus in fertilizer mixtures containing organic material, and a paper on this subject was given at the annual meeting of the Association of Official Agricultural Chemists. License tags were issued for 328,880 tons of fertilizer, the largest total for Kentucky on record. Release of semiannual inspection reports was begun this year.

During the year a number of samples of mixed fertilizer were received from farmers who claimed the fertilizer had damaged or killed tobacco plants. Practically all the nitrogen in these samples was derived from calcium cyanamid.

Feed control.— During the year 1,524 samples of feed were analyzed, of which 1,276 were official inspection samples and the remainder were samples sent in by farmers, dealers, manufacturers, and others. License tags were issued for about 579,446 tons of feedstuffs, about 54,000 tons less than the total for 1945. This is the first year since 1942 that tags have been issued for less than 600,000 tons. Throughout the first half of 1946, sales of feed tags were above all

previous years for the period, but they dropped sharply beginning the middle of July. In the third quarter, more than half of the samples analyzed failed to equal guaranty in one or more respects, chiefly because of the difficulty all manufacturers experienced in getting ingredients.

Fourteen suits filed for prosecution because of adulteration and misbranding resulted in fines and court costs. One suit was filed for selling feed without tags, which also resulted in assessment of a fine.

Release of quarterly inspection reports was begun this year.

Public Service Laboratories.— During the year a total of 27,364 foods, drugs, and public health specimens were examined in the several divisions of the department. Microscopical examinations were made on 6,622 smears for gonorrhea, of which 38.2 percent were positive; 135 smears from eyes of new-born babies were examined for gonorrheal ophthalmia, with 52 positives; 1,386 specimens of feces for intestinal parasites, of which 293 were positive for Ascaris or round worm, 134 positive for hookworm, and 112 positive for other intestinal parasites.

Microscopical examination of stained smears from 1,321 specimens of sputum showed 22.5 percent positive for acid-fast organisms, morphologically identical with *Mycobacterium tuberculosis.* Of 91 specimens cultured for tubercle bacilli on special media, 3 were positive.

Of 283 animal heads received for examination for rabies, 10 were unfit for examination. Of 273 examined, 118, or 43.2 percent, were positive for rabies—a sharp decrease in percentage of positive heads as compared with previous years.

Cultural examinations were made on 1,205 stool and urine specimens for typhoid, paratyphoid, dysentery, and Salmonella organisms. *Eberthella typhosa* was isolated from 10 specimens and organisms of the Salmonella group were found in 2 specimens.

Bacteriological examinations were made on 3,029 samples of milk, cream, ice cream and other dairy products for sanitary quality; 67 samples were examined for evidence of mastitis, and 144 samples of milk were cultured for pathogenic bacteria, of which 25 showed presence of hemolytic staphylococci, a toxicogenic organism frequently responsible for food poisoning. Chemical analyses were made on 2,888 samples of milk; of which 82 contained added water, 72 were low in butterfat, 6 contained a preservative. Of 577 samples received as pasteurized milk, 31 were under-pasteurized and 18 were grossly under-pasteurized or contained raw milk. Field agents for the War Food Administration submitted 83 samples of milk suspected of containing added water; only 2 showed such adulteration. City and County Health Departments of 28 counties submitted 2,747 samples of milk for sanitary examination and for establishing grades.

A total of 89 official samples of food, consisting of ice cream, butter, soft drinks and beverage concentrates, flour, meal, hamburger, sausage, and canned foods were received from the Division of Food and Drugs of the State Department of Health.

Examinations were made of 51 official drug samples of which 22 were disinfectants for chemical composition and for germicidal assay for bactericidal potency. A total of 15 samples of insecticide preparations were assayed for DDT content, and 7 samples of flour and meal were examined for weevil and rodent contamination.

Toxicological examinations were made of stomach contents and other organs in 9 cases of suspected poisoning of humans and 18 cases of suspected poisoning of livestock. Examinations were made of a wide variety of material submitted in connection with 32 cases of suspected poisoning or attempted poisoning.

Bacteriological examinations were made on 4,204 samples of drinking water for sanitary quality, 38 percent of which showed sewage or fecal contamination. Of 2,878 rural water supplies, 42.8 percent of the samples from cisterns, 53.8 percent of those from wells, and 78.1 percent of samples from springs were contaminated and unfit for drinking unless sterilized by boiling or treatment with chlorine. A total of 688 samples of water from wells, cisterns and springs used by rural schools, showed 43.2 percent contaminated. Many counties failed to submit samples of school water supplies. Of 1,173 samples from city water supplies that had been treated and chlorinated, only 3.6 percent failed to meet the bacterial standard for purity.

WESTERN KENTUCKY SUBSTATION

General farm production.— Excellent hay and corn crops and a good wheat crop were produced this year; barns and cribs are practically full of grain and hay. Pasture was abundant for both beef and dairy cattle. Apple yields were good but peach yields were very light.

The difficulty of obtaining adequate farm labor for both general and experimental work continued to be a definite problem. Nevertheless, by the use of young, unskilled helpers as extra labor, a large program of work was accomplished, and work is up to date at the end of the year. Wages were higher and all farm operations and purchases were more expensive this year.

Dairy herd.— The herd of purebred Jerseys averaged 17 milk cows, 20 heifers and calves, and 1 herd sire during the year. Average production per cow (D. H. I. A. records) from December 1, 1945, to December 1, 1946 was 6,593 pounds of milk and 350 pounds of butterfat; income per cow above feed cost was $202.25.

Beginning July 1 whole milk was marketed instead of cream,

a change necessitating certain improvements in the dairy barn and milk room to meet requirements for production of Grade A milk.

Use of DDT for control of flies on dairy cattle was begun this year. Cows, calves, and barn walls were sprayed with 2½-percent DDT in water, on May 10, June 13, July 24, and September 21. Each application gave satisfactory protection for about one month.

Hybrid corn yields.— Twenty-one hybrids and 2 open-pollinated varieties of corn were grown this year. Six kinds were replicated 3 times and the remainder were replicated 6 times in plots of 30 hills each, with hills spaced 3½ feet apart each way. Average yields for all replications were as follows:

White Corn	*Acre-Yield bu*
Ky 408	98.3
Ky 408B	96.5
Boone County White*	95.6
Ky 410	94.8
Ky 203	93.7
Ky 405B	92.3
Ky 226	92.2
Ky 72B	91.8
Indiana 901A	91.4
Ky 210	89.6
Ky 223	85.8
Indiana 703B	82.8

Yellow Corn	*Acre-Yield bu*
Ky 102	101.7
Dixie 44	96.8
Ky 137A	95.6
Ky 174	92.4
Ky 163	89.5
Ky 137B	87.6
Reid Yellow Dent*	87.3
Ky 103	85.7
Ky 148	85.3
Ky 158	82.9
U. S. 13	81.0

* Open pollinated

The season being unusually good for corn yields, the hybrids did not show as good increases as usual over the open-pollinated kinds.

Pasture experiments.— In this experiment on thin, sandstone soil, the effect of fertilization on pasture production is shown by gains made by yearling Hereford steers grazing three experimental 10-acre fields. The 1946 gains and the average gains for eighteen consecutive years of pasturing were as follows:

Treatment (Total for 19 Years)	*Pounds of Gain per 10-Acre Field*	
	1946	*18-Year Average*
None	875	477
3,207 lb Rock phosphate	2,225	1,625
1,663 lb Superphosphate and 2½ tons limestone	1,885	1,628

The 1946 gains were considerably above average for this test, the season being unusually favorable for pasture production. Another factor probably contributing to greater gains was the use, for the first time, of three 2½-percent DDT sprays for fly control. Gains from the untreated field were the highest in 18 years. A special effort

was made to graze the wild vegetation more closely in this field, early in the grazing season, by increasing the number of cattle carried and thus forcing them to eat more of it.

All-pullet flocks versus hen flocks.—In a comparison carried for 11 years, all-pullet flocks have proved definitely superior to older hen flocks in egg production—and definitely more profitable since annual production determines to a great degree the net income from the poultry flock. Average yearly egg production over the 11 years was as follows:

	Pullets	*Hens*	*Difference*
Barred Rocks	172.5 eggs	122.3 eggs	50.2 eggs
White Leghorns	172.0	137.5	34.5

Hatchability of eggs was slightly in favor of those produced by the pullets. Livability of the chicks was also slightly in favor of the group from the pullet eggs and was high in both cases.

This poultry flock is managed as a farm flock with breed improvement dependent on the use of pedigreed males. The results are therefore directly applicable to farm flocks of Kentucky.

Distillers' dried solubles versus meat scrap for young chickens.— Four pens, of 100 pullets each, were used to measure the effect of growth rations on first-year egg production. The results are summarized in the following table:

Protein Supplement in Growth Ration	*Egg Production per Pullet* (9-12-45 to 8-31-46)
Barred Rock	
Meat scrap	181
Distillers' wheat dried solubles	207
New Hampshire	
Meat scrap	195
Distillers' wheat dried solubles	166

Results were opposite for the two breeds, the Barred Rocks started on distillers' solubles producing more than those started on meat scrap, and the New Hampshires started on meat scrap producing more than those started on distillers' solubles. Pullets raised in 1945 on distillers' wheat dried solubles ate less protein feed than those raised on meat scrap and were later in maturing. This difference was very striking in the New Hampshire breed and may account for the slower maturing and the lower egg production. Apparently the distillers' wheat dried solubles were not very palatable to chickens.

In 1946 this experiment was continued with distillers' corn dried solubles fed in a mixture with an equal amount of meat scrap. In 4 broods of young chickens, 300 per brood, 622 pullets were raised to maturity. Two of the broods were Barred Rocks and two were

New Hampshires. One brood of each breed had free access to meat scrap and the other to the mixture of half meat scrap and half distillers' corn dried solubles. The mixture was apparently very palatable, as the Barred Rocks consumed 15 percent more and the New Hampshires 100 percent more of it than the pens receiving meat scrap alone as a protein supplement. Pullets receiving the mixture of distillers' solubles and meat scrap weighed 0.1 pound more per bird at 12 weeks of age and also at 23 weeks of age, than those fed meat scrap. Also the New Hampshires on the mixture matured earlier and laid more the first month of production than those on meat scrap without the dried solubles.

Effects of different legumes and grasses in rotations, on crop yields.—An experiment to determine the residual effect of various legumes and grass on the yield of corn and wheat, in a three-year rotation, has been in progress for 20 years. The 1946 yields of corn and wheat following certain hay crops were as follows:

	Bushels per Acre	
	Corn	*Wheat*
Red clover hay	73.7	21.3
Alfalfa hay	70.9	21.8
Sweet clover hay	70.6	26.7
Lespedeza hay	67.4	21.0
Timothy hay	63.1	14.2
Soybean hay	48.0	11.0
Cowpea hay	46.9	13.6

All plots have received the same phosphate and potash fertilizers and all except the last two have been limed.

Comparison of superphosphate and rock phosphate on sandstone soil.—Rock phosphate and 20 percent superphosphate are being compared in an experiment begun in 1930 on sandstone soil. A three-year rotation of corn, wheat, and hay is followed. The phosphate is applied once in the rotation when wheat is seeded. Both coarse-ground and fine-ground rock phosphate have been used on separate plots. All phosphate treatments were supplemented alike with potash and nitrogen fertilizers and manure. The 1946 yields on both limed and unlimed land are shown in the table below:

*Treatment**	*Yield per Acre*		
	Corn (bu)	*(Wheat bu)*	*(Hay lb)*
Sp	53.7	27.6	2560
FRp	61.7	24.9	3800
LSp	54.9	28.9	3480
LFRp	56.6	24.3	3800
LRp	62.3	21.8	3960

*Sp = 300 lb 20 percent superphosphate per acre
FRp = 375 lb 32 percent fine rock phosphate (200-300 mesh) per acre
Rp = 375 lb 32 percent coarse rock phosphate (100 mesh) per acre
L = ½ ton limestone per acre each six years.

Applied at the above rates, rock phosphate supplies two parts of P_2O_5 to one part in superphosphate. Results in past years have been similar, but have shown greater increase in hay yields from use of limestone with rock phosphate. One-half ton of limestone each six years, is probably too small an application to get maximum results from the limestone and superphosphate combination.

Dark tobacco varieties.— Twelve standard dark tobacco varieties and seven mosaic-resistant hybrids were grown this year. The less desirable kinds were eliminated in past years and most of those now being grown in this test are good. Average yields for past years by varieties are shown below:

	Years grown	*Acre-yield, lb*		*Years grown*	*Acre-yield, lb*
Improved One Sucker	12	1418	Black Kelley	17	1336
Clarksville Broadleaf	17	1401	Broadleaf Greenwood	19	1332
Little Orinoco	18	1358	Improved Smith Type	16	1327
Broadbent	20	1358	Madole	19	1292
Little Crittenden	19	1344	Brown Leaf	18	1224
Rudolph Improved	17	1343	Owensboro Greenwood	15	1217

Yield, type, and quality of all the above kinds have been satisfactory. Brown Leaf and Owensboro Greenwood have made the smallest yields, each being an early-maturing, narrow-leaf type, but are usually highest in quality.

Mosaic-resistant strains of dark tobacco, developed at the Kentucky Agricultural Experiment Station, have been grown in field trials here for 8 years. The seven strains grown this year are definitely resistant to mosaic, are of medium to good dark type, and produce leaf of good quality. Four of the seven (Ky 150, Ky 151, Ky 153, and R27-44) are Brown Leaf crosses, which usually grade higher than the standard varieties but yield slightly less. The other three mosaic resistant strains are crosses with Little Crittenden, Little Orinoco, and One Sucker. These have made high yields but usually grade slightly below the Brown Leaf crosses.

Nicotine from green tobacco.— An experiment to determine the commercial feasibility of growing tobacco for its nicotine content was carried on this year in cooperation with the Tobacco By-Products and Chemical Corporation of Louisville. One-half acre plots of *N. rustica*, an imported species of Nicotiana, and Ky 153, a mosaic resistant strain of the species *N. tabacum*, were grown on heavily fertilized soil. Labor records were kept on the entire operation for each species. Periodic harvests were made to determine the yield of nicotine at different stages of maturity. The uncured tobacco was trucked directly from the field to the Tobacco By-Products and Chemical Corporation plant in Louisville for the extraction of nicotine. Acre-

yields for *N. rustica* ranged from 5.0 to 6.1 tons of green tobacco and 124 to 133 pounds of nicotine. Acre-yields of Ky 153 ranged from 5.4 to 6.8 tons of green tobacco and 106 to 122 pounds of nicotine. As judged by yields and labor costs in this test, the growing tobacco for nicotine and harvesting it green, as in this test, would probably not be commercially feasible.

Red clover varieties.— Of 6 strains of red clover, replicated 3 times on small plots, Ky 215 produced the highest yield in both first and second cuttings. Cumberland, Southern Selection, and Midland all yielded about 17 percent less hay than Ky 215, and Oregon and Wisconsin strains produced 35 percent less than the Kentucky strain.

Apple orchard cover crop.— The average yield of all varieties (20-year old trees) was 9.5 bushels per tree on the cultivated plot and 12.4 bushels per tree on lespedeza sod. The use of a straw mulch around some of the trees in lespedeza sod gave only a slight increase in yield. By varieties the averages were Stayman, 20.6 bu; Delicious, 7.5 bu; Winesap, 13 bu; and Yellow Transparent, 4.5 bu. Delicious did not set a full crop, and more than half of the Yellow Transparents had a very light set. The Stayman crop was unusually good, with a heavy set of large apples which matured without cracking. Winesap trees were heavily loaded, but most of the apples were very small—as frequently happens with Winesaps in this planting on thin sandstone soil.

Trunk girth, 6 inches above ground, increased an average of 1½ inches per tree this year. Yellow Transparent made the greatest growth, Stayman second, Delicious third, and Winesap the least.

Control of worms and diseases in apples was more complete than in recent years, probably because of more favorable weather and the use of DDT. A total of 13 apple sprays were applied. Control of red spider and mites became an added problem because DDT destroyed the parasites which usually are helpful in keeping these insects in check.

Apple varieties.— Lodi again produced heaviest among the very early sorts, including Yellow Transparent, Red Bird, and Starr. Ratings of fruit from largest to smallest were Starr, Red Bird, Lodi, and Yellow Transparent on May 29; and Starr, Lodi, Red Bird, and Yellow Transparent on June 10. Starr is outstanding for size of fruit, but so far the trees have not been very productive. Of the second-early sorts, Anoka produced another good crop and is setting a record here for early, heavy production. Polly Eades, Paducah, and Holland also produced good crops again in 1946. Young Wealthy trees, however, that bore a heavy crop in 1945, have already gone into alternate bearing and produced nothing this year. Of the later sorts, Jonathan,

Grimes, Jonared, Conard, and Fyan produced heavy crops, and Turley, Staymared, Gallia Beauty, and Faurot produced only light crops.

In the older cover crop and cultural plots Staymen and Winesap bore heavy crops, Delicious a lighter crop, and many of the Transparent trees had no fruit this year.

Peach varieties.— Partly as a result of arsenical spray injury in 1945, there was a light set of fruit buds in the peach variety planting in 1946, especially where a heavy crop was produced in 1945. Several frosts after blooming slightly reduced the already light set of fruit.

Varieties that produced the heaviest crops in 1946 were Cumberland (missed in 1945), Erly Red Fre, Early Rose, Raritan Rose, Triogem, Halehaven, Viceroy, Hiley, Veteran, Ideal, Summercrest, K43, Golden Gem, Afterglow, and Barbara. New varieties that showed promise as shipping sorts were Erly Red Fre, Redhaven, Triogem, Halehaven, Summercrest, F. V. 9-93, K63, Sullivan's Early Elberta, Kalhaven, Afterglow, White Hale, and Barbara. Others of high quality that gave promise of general usefulness were Sunhigh, Goldeneast, Georgia Belle, July Heath, and Ambergem.

Varieties listed for discard, because there are other better ones of the same season are Early Rose, Oriole, Gold Aflame, Alton, Slappy, and Redelberta; also Sure-crop Nectarine and Cardinal Heath because of brown rot damage.

Plum varieties.— All plum varieties suffered considerable arsenical spray injury in 1945. In 1946 most varieties produced a very light crop, the lightest in several years. Varieties bearing a full crop in 1946 were Munson, Shropshire Damson, and Blue Damson. A partial crop was borne by Bruce, Early Italian Prune, Italian Prune, and French Damson. Gold, America, and Compass produced practically no fruit. Compass was again, for the third straight year, seriously injured by blossom-stage brown rot, indicating that this variety is unsuited to conditions in the Princeton test orchard.

A test parcel post shipment of Bruce Plums, picked when the first tinge of color appeared, reached Lexington in good condition and ripened with good quality. In some sections the fruit from large plantings of this variety is marketed profitably when picked at this stage and sent to market in small containers.

Grapes.— Three severe frosts (April 13, 17, and 27) froze back virtually all new growth in the grape vineyard on each occasion and virtually ruined the 1946 crop on all varieties. Only occasional late bunches were borne by any varieties. For several consecutive years the grape crop has been damaged by frosts. The vineyard is on land assigned for horticultural use and is one of the lowest spots on the Substation farm. Grapes need an elevated site with good air and water drainage.

Blackberry varieties.— Brainerd, Young, and Boysen varieties were removed from the blackberry planting early in 1946 because of repeated loss from severe winter killing. The blackberry planting, like the grape vineyard, is on low ground. Apparently these varieties of blackberry, if planted in Kentucky, should be set only on high, favorable sites and in the extreme southern parts of the state. Ozark Beauty, Eldorado, Early Harvest, and Alfred set heavy crops of fruit in 1946 but the berries were small because of the extended June drouth, and Alfred suffered further heavy losses from orange rust. Orange rust has now virtually eliminated Alfred from the planting. For the first time Ozark Beauty had an occasional plant affected with orange rust this year. Early Harvest and Eldorado have had slight annual loss from orange rust but have not suffered to any real extent.

Strawberry varieties.— Highest-yielding commercial shipping berry in the 1946 test was Tennessee Beauty, with 180 crates per acre. Tennessee Shipper had 157; Blakemore, 119; and Aroma, 70 crates per acre. Tennessee Beauty not only yields better than Aroma (both late shipping berries) but also is far superior in shipping quality and ability to stand adverse weather conditions. On the average, at Princeton, Blakemore has yielded considerably more than Tennessee Shipper, but the fact that Tennessee Shipper sometimes outyields Blakemore and is more resistant to rotting in wet seasons justifies its use in trial plantings and limited commercial acreage. Tennessee Supreme gave the heaviest yield, with 201 crates per acre and strengthened its claim to top rating among local-market and quick-freezing varieties. A number of unnamed selections from the U. S. Department of Agriculture produced in the neighborhood of 100 crates per acre each and are in line for further testing.

Average acre-yields at Princeton during the 5 years 1942-46 were as follows: Tennessee Supreme, 192; Tennessee Beauty, 185; Blakemore, 180; Tennessee Shipper, 155; and Aroma, 73.

So far yellows has not shown up in a strain of Blakemore received from the U. S. Department of Agriculture in 1939. Occasional yellow plants continue to appear in the McUmber's Yellows Resistant Blakemore variety.

ROBINSON SUBSTATION

General farming.— Crops were good in spite of much wet weather and a shortage of farm labor. Except for 2 acres practically lost because of wet weather and weeds, the hybrid corn (Ky 103) averaged better than 70 bushels of good quality corn per acre. One 2-acre plot was seeded to clovers and grasses for permanent pasture, making a total of 12 acres of good permanent pasture on the farm.

Three 6-acre plots were seeded to Korean lespedeza, and 3 acres were seeded to alfalfa. Oat hay was saved from 9 acres; mixed hay (red clover, lespedeza, orchard grass, and fescue) from 6 acres; Korean lespedeza from 6 acres; alfalfa, one cutting, from 3 acres; soybean hay from 4 acres; and wheat and rye were mowed from 3 acres of young grass and clover.

Livestock and poultry.—The project of breeding up of scrub and grade dairy cattle by the use of purebred Brown Swiss bulls was in its fourth year. There were this year 3 calves of the third generation, two of which calves are three-fourths Swiss and one-fourth scrub and the third calf is three-fourths Swiss and one-fourth Jersey. All three are solid color and very much resemble the Swiss breed. In the herd as a whole there are 33 cattle. Ten head were sold during the year.

Fruits.—Late spring frosts virtually destroyed the peach crop in the variety orchard; but a good apple crop was produced in the main orchard. Several varieties in the 1939 setting of apples on bottomland produced good crops.

Nuts.—In the nut planting the 1946 crop was reduced by spring frosts and freezes; but a light crop was produced on Major, Busseron, and Green River pecan varieties. The Busseron nuts were seriously injured by pecan scab. A number of new trees and varieties have been ordered for addition to the small, thriving, improved nut planting at Quicksand.

Sorghum varieties.—Two old Kentucky varieties of sweet sorghum, Cedar Ribbon and Black Top, were tested in comparison with the Williams variety. Cedar Ribbon produced 113.3 ten-pound pails of 80-percent sirup per acre; Black Top 110.2 pails; and Williams 174.7 pails. Sirup produced by Black Top was poor in color; that produced by Cedar Ribbon was good but inferior to that produced by Williams.

NEW PROJECTS - 1946

Priming of burley tobacco.

The composition and nutrition of burley tobacco, with special reference to the effects of nitrogen and potassium fertilizer salts.

Investigations on hemp and hemp fiber production.

Tests of response of general field crops to fertilizers.

Control of wild garlic and wild onions in small grain fields and in meadows and pastures.

The iodine content of important fertilizer materials and their effect on the iodine content of important farm crops and livestock.

Factors affecting the utilization of forage by late lambs.

A study of comparative rates of growth and calcification of the larger bones of male and female chickens with and without crooked keel.

Investigation of the riboflavin content of livers of animals that store fat easily and the amount of depot fat in such animals.

Effects of fiber in poultry rations.

Investigation of frozen eggs in relation to their use in cooked products.

Histopathology and chemical pathology of non-infectious diseases.

Investigations with D D T (dichloro - diphenyl - trichloroethane) against certain insect pests.

Marketing feeder pigs in Kentucky.

Cost and income in producing farm products in representative areas of Kentucky.

Social effects of the returning rural migration.

Rural groups and institutions in Kentucky.

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481. Negro population of Kentucky. H. W. Beers. January, 1946.
482. Survival of Nematode parasites of sheep on pasture during summer. E. R. Doll - and F. E. Hull. March, 1946.
483. An analysis of prices of veal calves. A. J. Brown. April, 1946.
484. Costs in owning and operating farm implements and machinery in Kentucky. George B. Byers. April, 1946.
485. Effects of soil, soil treatment, seasonal variation, and variety on yield and composition of corn crops grown on Kentucky soil fertility plots. M. E. Weeks and E. N. Fergus. May, 1946.
486. Value and use of tobacco stalks in farm practice. M. E. Weeks and P. E. Karraker. May, 1946.
487. Urban adjustment of rural migrants. A study of 297 families in Lexington, Kentucky, 1942. Catherine P. Heflin and Howard W. Beers. June, 1946.
488. Timber-products marketing in Eastern Kentucky. William A. Duerr, John Roberts, and R. O. Gustafson. June, 1946.
489. The identification of some larval Elateridae found in Kentucky. H. H. Jewett. June, 1946.
490. Seasonal variation in prices of veal calves. A. J. Brown. June, 1946.
491. Farm management and family incomes in Eastern Kentucky. W. D. Nicholls and J. H. Bondurant. June, 1946.
492. Deformed bones of chickens. I. Crooked keel. II. Osteopetrosis and Osteoma. G. D. Buckner, W. M. Insko, Jr., and Amanda Harms Henry. June, 1946.
493. Forest fires, basal wounds, and resulting damage to timber in an Eastern Kentucky area. R. O. Gustafson. October, 1946.
494. Tree volumes and timber yields in the Breathitt area of Eastern Kentucky. R. O. Gustafson and Benn L. Hornbeck. November, 1946.
495. Effects of four all-mash rations on laying hens. G. Davis Buckner, W. M. Insko, Jr., Amanda H. Henry, and Elizabeth F. Wachs. December, 1946.
496. The relation of curing conditions to quality in white Burley tobacco. R. N. Jeffrey. December, 1946.

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46. Quarterly report on official feed samples analyzed by the Feed and Fertilizer Department, Kentucky Agricultural Experiment Station, January-March. May, 1946.
47. The Kentucky pure seed law and its administration. W. A. Price. June, 1946.
48. Commercial feeds in Kentucky in 1945. By J. D. Turner, Stacy B. Randle, W. G. Terrell, V. C. Midkiff. July, 1946.
49. Commercial fertilizers in Kentucky in 1945. By J. D. Turner, H. R. Allen, and Lelah Gault. July, 1946.
50. Some items of interest to Kentucky Nurserymen. For the year ended June 30, 1946. W. A. Price and Howard G. Tilson. July 1946.
51. Quarterly report on official feed samples analyzed April, May, and June, 1946, by the Feed and Fertilizer Department, Kentucky Agricultural Experiment Station. July, 1946.
52. Seed inspection in Kentucky, 1945-46. W. A. Price, E. C. Vaughn, Encil Deen, Howard Tilson, Alice McDaniel, Margaret Morton, Mary Lee Anderson, Lucy Baugh, Charlotte Cundiff, Edna Marrs, and Frances Cooke. September, 1946.
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54. Quarterly report on official feed samples analyzed by the Feed and Fertilizer Department, Kentucky Agricultural Experiment Station, in July, August, and September, 1946. November, 1946.

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FINANCIAL STATEMENT

Receipts and expenditures under Hatch, Adams, Purnell, and Bankhead-Jones Acts, and the State Offset Required by the Bankhead-Jones Act.

Fiscal year ended June 30, 1946

	Hatch	*Adams*	*Purnell*	*Bankhead-Jones*	*Bankhead-Jones Offset*
Receipts					
From the Treasurer of the United States as per appropriations for fiscal year ending June 30, 1946	$15,000.00	$15,000.00	$60,000.00	$88,327.80	
Receipts from sources within the state as Bankhead-Jones offset					$88,327.80
Expenditures					
Personal Services:					
Administration	3,500.00				
For all other purposes	10,440.00	14,853.27	54,252.35	82,278.11	
Travel	169.23		2,017.75	1,013.58	
Transportation of Things		3.79	4.94	36.97	
Communication Service			70.08	2.25	
Rents and Utility Services:					
Rent of space in buildings or equipment					
Printing and Binding:					
Printing publications	890.77		3,134.48	843.39	
Other printing and binding			3.00	490.82	
Other Contractual Services:					
Repairs and alterations to equipment, and other contractual services not otherwise classified			157.29	337.50	
Supplies and materials		142.94	340.86	1,433.62	
Equipment			19.25	1,891.56	
TOTAL EXPENDITURES	15,000.00	15,000.00	60,000.00	88,327.80	
Unexpended balances June 30, 1946	.00	.00	.00	.00	
BANKHEAD-JONES OFFSET, TOTAL APPROVED EXPENDITURES					$88,327.80

We, the undersigned, certify that the receipts and expenditures shown in this report from Federal funds and as offset to Bankhead-Jones funds are correct; that the expenditures were solely for the purposes set forth in the acts of Congress approved March 2, 1887 (Hatch), March 16, 1906 (Adams), February 24, 1925 (Purnell), May 16, 1928 (Hawaii), February 23, 1929 (Alaska), March 4, 1931 (Puerto Rico), June 29, 1935 (Bankhead-Jones, Title I), June 20, 1936 (Alaska), and March 4, 1940 (Employer Contributions to Retirement); that the expenditures are in accordance with the terms of said acts so far as applicable to this station; and that properly approved vouchers are on file for all expenditures.

Signed:

THOMAS COOPER
Director of Experiment Station

FRANK D. PETERSON
Comptroller

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